THE PRINCIPLES OF URBAN TRAFFIC

H. W. D. STONE

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BY

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THE PRINCIPLES OF URBAN TRAFFIC

CHAPTER I

INTRODUCTORY

The Science of Transportation—Ideal of Traffic—Ineffective Legislation—Fallacies of Noise.

THE subject dealt with in the following pages is one which up till now has received very little thoughtful attention from the world at large. Possibly the reason for this is that, until the advent of mechanical transport, the pressure on our roads was not sufficiently great to necessitate any serious effort to relieve it.

Of late, however, the problem has forced itself into the public eye very insistently, and many urban authorities have been forced to make some provision for the increase of traffic that has actually arisen, and which is still more likely to be felt in the future.

The magnitude of the issues involved can be seen in the appointment of commissions to consider the question in more than one town, but the conclusions of these commissions are, as it seems to the writer, so divergent, that some effort may be made to formulate the basic principles of urban traffic, in order that there should be no antagonism of ideas on these primary questions in the future.

It may seem somewhat arrogant to speak of the science of transportation, yet it cannot be otherwise described, if science is regarded as common sense specialised; and if we follow true common sense in our arrangement of urban traffic, we shall find that so much specialisation of thought is necessary for the appreciation of all the problems arising therefrom, that the term science is not unreasonable.

Traffic of all descriptions conforms to certain natural laws, which may or may not be apparent—it rests merely to discover them. Once this is achieved, the improvement can at once be taken in hand with a certainty of result, in distinction to so many attempts hitherto, which can only be termed disappointing in that they have mostly had the effect of leaving matters worse than before the attempt.

To begin with, it will be well to come to a definite agreement as to the ideal which must be striven for. This is perhaps stated best as "Speed without offence": in other words, every one must strive to get over the ground as quickly as possible without constituting himself a nuisance to others. Inasmuch as we are all equal in the eyes of the law (though most of us think ourselves better than our neighbours, particularly from a motor car), it cannot be admitted that any individual has by virtue of his wealth or weight the right to use the road as he chooses, without regard to the feelings of others, just as worthy, but possibly less wealthy than himself. This was pretty well recognised by road users before the advent of the motor car, and road offence was, in England at least, a rare misdemeanour. When, however, legislators chose to treat the motor car as something apart from ordinary traffic, something which the general public had to avoid as a dangerous animal, instead of treating it precisely as other vehicles are treated, it is not surprising that trouble ensued.

As a direct result of the legislation, combined with the inherent brutality of the human race, motor cars have universally fallen short of the traffic ideal in the matter of inoffensiveness. They have realised it in respect of their speed, but at the cost of the animosity of the rest of the community. And all the trouble and damage they have caused may be said to be largely attributable to that absurd practice—a law in England—which turned the civilised man into a savage by enjoining him to yell, or its equivalent, as he approached his victim. This paved the way for that excessive speed which is now a feature of our existence.

Immunity is not to be sought or found in noise—proof of that is established already by the number of accidents, some of them fatal, which have occurred to motor car users themselves—but in the care which each driver exercises, and nothing should be introduced which in any way can be thought to replace the indispensable consideration for other road users.

Such legislation alone should be sufficient justification for an attempt to define the principles of traffic, if it were not further called for by the poverty of result obtained by local authorities and officials in their efforts to improve the physical state of their traffic.

Once it is recognised that speed can exist without excessive noise and dust, and in spite of congestion, we have gone some way towards solving our present difficulties. In traffic, as in all other matters, every effect has a cause, and if we admit that the removal of the latter is equivalent to the removal of the former, some progress can be made towards improvement. But if we are content merely to treat the symptoms and perform experiments for their removal in the hope that one of the cures tried may be the correct one, the problems will be only the more exaggerated and difficult for future generations.

It must, however, be borne in mind that only general principles can ever be considered in such matters, and that all details must be left to local experts for their adoption: unfortunately it is the frequent ignoring of these first principles that necessitates the mention of this elementary fact.

In support of the principles to be enunciated, recourse to example will be had as sparingly as possible, because example is of very little use to those who have not learned the principles: to those who have, it is of equally little use, because the finding of examples of all phases of traffic is then entirely simple.

In matters of principle there can be no variation; in practice there is, on the other hand, no finality. Constantly changing conditions lead to constant changes of detail in the conducting of traffic, but so long as the principles which govern the whole question are observed, variation in matters of detail is to be encouraged as tending to a greater ultimate advancement.

The principles which it is sought to establish have been reduced as far as possible to concrete arithmetic. That this method presents drawbacks in such an elusive and variable subject as traffic is not denied, but it has the advantage of enabling students of the question to examine it more closely and arrive at a more definite decision than is possible if any looseness of argument is allowed. Since the advent of the motor car there has been a large increase in the study of the problem, even if often unconscious, by the drivers of private cars, but the result of their experience is not formulated, and so little advance in the understanding of the general problem has accrued. That the arguments advanced in the following pages will be accepted in their entirety is not expected, but perhaps the very rejection of some will lead to other students formulating the correct principle, acceptable to all shades of opinion.

In applying these principles to "urban" traffic, it must not be assumed that they differ from those of rural traffic, but only that the need for their observation is less important in country districts, as traffic problems arise only in spots of great housing density, such as do not exist except in towns. Yet since every town was country once upon a time, in physical respects country roads should conform to the standards laid down, so as to be prepared for possible developments in the future. In fact these principles are of equal value to the older and more established cities, and to those new townships which spring up all over the world: to the latter perhaps more useful, as with a clean slate there are no miscalculations to correct and erasures to be made, so that the true principles can be applied from the start.

CHAPTER II

THE HUMAN FACTOR

The Pedestrian—His Impulses—Prime Cause of Urban Traffic—Supply Creates Demand—Influences of Traffic—Facility and Resistance Factors—Speed, Cost, Comfort.

In the consideration of urban traffic one great point stands out on all sides, and that is the human factor. To go to first principles, the original and prime factor of all traffic is the pedestrian, the human being. Without him there would be no movement of vehicles, which is simply a development of the needs of the pedestrian.

Man's impulses are, however, governed by a natural law, so fundamental that it is almost impossible to provide exactly for all the phenomena which result therefrom, but nevertheless it rules the entire subject of traffic, and its ramifications must therefore be clearly understood. Man follows the line of least resistance, and it is this prime law that has to be understood and regarded in all questions relating to the improvement of traffic. Any scheme not in accordance with this primary law may be put aside.

The rise of urban traffic may be taken roughly as dating from the foundation of railways. Prior to that, communications were so restricted that towns did not give the same social advantages which they now afford; besides, the very getting there was an additional barrier which is now removed, and which prevented any large fluctuation of the population on any day. Now, however, conditions are so changed that it is relatively easier to traverse twenty miles of country than ten of town, and this fact, coupled with the exceptional facilities to communication among themselves afforded to their residents, has imposed a strain on the arteries of traffic such as was never contemplated when the roads were originally built.

Traffic, therefore, may be said to respond in proportion to the supply; consequently new classes of traffic have arisen such as were unknown in the pre-railway days. It is only necessary to mention the shopping or theatre traffic, in forming which many residents of the outer suburbs and beyond frequent the large town to a degree that was impossible before on account of the resistance to their impulses offered by inferior facilities for giving way to them. And so traffic has grown until the resistance point has again been reached by possibly some local inducement to waive the tedious journey to town, in the shape of a good local emporium or theatre. And then there is created an internal suburban traffic—an *imperium in imperio*—where precisely the same causes operate to affect traffic conditions, so exemplifying the cardinal principle above quoted.

The point, therefore, which is of importance in considering the behaviour of the human being is what constitutes a resistance, or conversely a facility, and this demands careful attention, since it is at the root of the whole problem.

First and foremost comes speed. The first inducement present in the human mind in the institution of any new traffic facility is the saving of time to the traveller. "Time is money," and the saving of time is translatable into currency. The truth of this axiom is seen in many forms of transportation in differential charges for speed, but it is capable of wider application than merely to prices. If people are willing so generally to embark their capital in new ventures having for their purpose the reduction of time of transit as a main idea, it must be because they find that this factor in travel is the one which appeals most to humanity. And in practice this is borne out by results. The railway everywhere displaces the coach or water traffic, the motor-driven vehicle the horse-drawn, the steamer the sailing vessel. Speed, then—which is equivalent to the reduction of distance, or to the knitting together more closely of the scattered inhabitants of the earth, or to the lengthening of their lives—is the first factor.

In addition to speed as a factor in transport, there are two others, namely cost and comfort. All these three contribute in varying ratio to make up the necessary amount of facility to cause the individual to travel or to dispatch goods. To exemplify this as regards passenger traffic, let us turn to the Atlantic liners, where speed commands an excess of price over mere comfort unassisted. The accommodation on these vessels is more or less equal as a whole, but the higher speed vessel can charge higher fares for that virtue. The same is seen in railway travel on the Continent, where the highest speeds are obtainable only at an enhanced price. Where, however, speed and comfort are equal, cost becomes the deciding factor, as can be seen in excursion or pleasure traffic generally.

In the question of competitive traffic, the importance of these three factors has especially to be studied. In England the cost factor has been eliminated from long distance traffic, while speed between competitive points varies but slightly, so that the main factor is comfort. In urban traffic, however, the methods of transport are so varied that the individual can study his propensities in either of the three factors each time he travels.

In urban traffic speed is of relatively greater importance over large distances than over small, cost is practically unvarying throughout, while comfort, or convenience, gains in importance as the distance to be traversed grows shorter.

Thus these varying components, when combined in a traffic service, form the facility for the individual, and effect it in proportion as they fall short of the demand, to an extent which it is unfortunately impossible to define. As the individual becomes more educated in matter of comfort, so he cavils at the speed—or vice versa, and so the standard of supply is constantly being forced upward. What was regarded as sufficient facility ten years ago would be somewhere about 60 per cent. only of the present standard; that is to say, there is always some improvement in practice possible which will further increase traffic, while, as soon as one improvement is effected, the way is merely paved for another, and so the snowball rolls on.

With such an attribute governing the actions of the primary component of traffic, it must be continually borne in mind that unless conditions are made as suitable as possible for him, all the calculations based on him as a mere machine are perfectly useless, for he will simply ignore them and go his own—*i.e.*, some other--way. If, on the other hand, matters are so arranged from the human point of view that he finds it easier to do right than the reverse, if, in fact, we coax him rather than attempt to drive him, it will be found that it is not so impossible as has been generally thought to improve the conditions of traffic in towns, however congested, and by watching his behaviour under changes of conditions we may gradually arrive at a maximum of facility and efficiency for the physical means at our disposal.

CHAPTER III

ROAD PLANNING

Roads the Prime Medium—Reasons for their Growth—Lack of Principle in Planning—Roads furnish Resistance as well as Facility for Traffic—What are Road Resistances?—Growths of Arterial Roads—Congestion Caused by Road Attractiveness—Existence very Local—Remedies—Excessive Congestion—How Caused—Speed Variations arising from Road Design—Intersections—If wide enough, no Obstruction—Rule for Requisite Size—Circuses and their False Principle—Abolishing Intersections—Its Effect—Objections—Convergences—Their Obstructiveness—Road Width—Effect of Parks and Open Spaces in Towns—Housing.

The main arteries of all urban traffic, with the exception of a few towns such as Venice perhaps, are their roads, and their importance on this question cannot be too highly considered. They have the greatest bearing on the general trend of traffic, being the prime means of all urban transport. Man's natural propensity is first to walk, and then to travel by artificial means, and the less artificial in practice these means are, the more he will use them. This is, in fact, a mere reiteration of the primary rule of his following the line of least resistance.

Roads are, in fact, the example of man's desire to reduce the resistance to travel offered by his first choice of water as a means of conducting traffic, this being chosen on account of the difficulty of traversing the land economically in its natural state. In effect, roads being difficult to construct, were built only as the spread of population and civilisation required them, and as population followed natural arteries of traffic, the first roads, except those built for military purposes, conformed therewith.

To this lack of science in road planning is attributable the extreme congestion of the older parts of flourishing cities; their age has rendered them more populous, desirable, and central, while the facilities for dealing with the population were planned, if such a term can be used, on a basis of some tiny fraction of the present demands. This mistake is not so likely to occur in the laying out of new towns, as the importance of adequate roads is now fully realised. The actual road planning itself is, however, far from being so understood, and we will discuss in due course its principles when we have disposed of the existing arteries.

Roads, being the primary means of all traffic, contain the bulk of the forms of resistance thereto. These consist of indirectness, bad grading, congestion, and what is actually known as road resistance, bad surface. These four factors form the "facility" value of any road, and are as variable in amount as the "facility" value of the general means of traffic explained in the first chapter.

Indirectness will often be overlooked to avoid a steep hill, or a bad surface, or a crowded street, and so with the other factors; the one depends on the others, and they are continually interacting.

Inasmuch as the function of roads is to enable traffic to be conducted, the maximum of facility must be sought for in all of them. As regards directness and gradients, some roads are bound to show an inferiority compared with others; in road surface, however, the full value of the factor can be maintained in all cases—it is simply a question of efficient management and funds. That the latter question is of cardinal importance can be seen by anyone who realises that it is superiority of one road surface to another that leads to its congestion. This last, the chief destroyer of the facility of our roads in towns, will be considered at length later.

Originally the village came into being along the high road, which was the sole means of traffic at that time. Gradually, as the village prospered, new lanes were made at angles to the road to provide access to houses away from the main road. These lanes again became connected up by cross lanes, running more or less parallel to the high road, and so the village grew into a town, and the town into a city, with the same high road in the centre. This high road, however, was not only a local artery; it was a through road, and therefore had a great deal of extraneous traffic to provide for. Naturally, then, this was the first road to be attended to, on the principle presumably of the greatest good to the greatest number, and so the traffic continued to be attracted there and to increase. Had some far-sighted person devoted his energies to the linking up of the parallel lanes and improving their gradients' directness and surface, the strain on the high road would have been greatly diminished, possibly to the extent of creating excessive congestion in the improved lanes.

Congestion is the natural result of road attractiveness, and by far the largest portion of road attractiveness lies in its surface. In a city like London the streets are commonly spoken of as extraordinarily congested—so they are, in a very few instances. If only the roads adjoining some of the most congested streets were better paved, a considerable portion of traffic would be attracted to them; if disconnected roads were linked up, they would become arteries, and so help to spread the burden now borne by the one road.

Most of the side roads in big towns leave no option to the traveller but to avoid them; all inducements are in the direction of his using the main thoroughfare, and adding to its congestion.

It will be well therefore if it can be agreed now that the total road space of any town is more than sufficient to accommodate all possible traffic, if only the traffic were properly dispersed over it instead of being concentrated in one or two. Even in the most congested traffic areas (as distinct from roads) such as the city of London, or the southern portion of New York, many streets can be found absolutely deserted of any but pedestrian traffic, and the object of the trafficist must therefore be towards the better utilisation of the existing space, before any attempt is made to provide more on an independent scale. Many a road by a small extension here or there would give an alternative route through from point to point, which, if suitably paved, would soon be utilised, to the easing of the other thoroughfares, and at a cost and in a time which would be only a small fraction of the making of a new road.

Having satisfied ourselves on the point of the original cause of all congestion, we have still to consider the excessive congestion arising in certain streets, which in many cases creates an absolute barrier to traffic. Certain roads of particular directness and physical superiority can never be completely free from congestion, but this does not mean that it will be continually impossible to move there. Excessive congestion converting a road into a yard is always due to actual obstruction, which arises in streets either from the placing of obstacles in the route of traffic which additionally narrow the street, from the obstruction caused by the variable nature of the speed of the several components of its traffic, such as standing vehicles, "crawling" cabs, and loaded drays, etc.—every slower vehicle is an obstruction to the faster—or finally, from the obstruction caused by the intersecting of various streams of traffic.

The first class of obstruction, *i.e.*, stationary obstacles, is easily remediable—they should be removed.

The second, varying speeds, is responsible for a great deal of congestion in streets, and creates the demand for "wide" roads. Any width more than sufficient to pass one stream of traffic in each direction is necessitated only by the variation in the speed of the vehicles composing the traffic. If all vehicles moved at a uniform speed there would, of course, be no wishing to pass. With variable speeds, however, a capacity so limited would mean stopping the whole column behind if one vehicle stopped, and similarly the reduction of the general speed to that of the slowest component. Therefore additional width is necessary to allow the faster traffic to pass the slower.

In exemplification of the foregoing, let us take the case of the Rotherhithe tunnel under the Thames, which is 1·3 miles in length. Here provision has been made only for two currents each 8 ft. wide. Assuming vehicles 30 ft. long over all, the tunnel could accommodate 229 vehicles in each stream, which, moving at a uniform rate of 8 miles per hour, would allow the passage of some 1,400 vehicles in each stream, or a gross traffic of 2,800 vehicles per hour. This is practically the equivalent of the maximum capacity of any of the busiest intersections which were counted in London for the Royal Commission, the absolute maximum being at the Marble Arch with just over 3,000. It follows therefore that bridges, tunnels, and roads, where there are no houses flanking the streets, and no junctions, do not require nearly the same width for the passing of the same volume of traffic as roads in towns.

Variable speeds, however, must exist, and due allowance must be made for them in our street widths. But there is no need for the streets themselves to add to this speed variation by their design.

It is a general practice to lay out streets at right angles to each other more or less, without any attempt to soften the angle of junction. The effect of this on traffic is very harmful. Traffic moves naturally and fastest in straight lines, and any deflection in the course entails increase of power or decrease in speed. In any case it generates friction, in proportion to the severity of the angle of deflection. The effect of this is to slow traffic excessively at certain points, and so cause unnecessary speed variation between deflecting vehicles and direct vehicles. This can be avoided by cutting off corners, so that the angle of incidence of even a rectangular junction is never less than 135°. If such a principle were adopted, it would be found that a large increase would have been given to the capacity of our streets. And in many cases this could be effected by a mere reduction in the space of the pavements at corners, of which there are many spots in London with unnecessary width.

It is, of course, apparent that as traffic deflects on a curved line, the maximum efficiency of such a cut-off is reached only when the corner is curved at the radius of a circle inscribed so that the converging lines form tangents of the arc equidistant from the point of convergence (Fig. 1).

The third, and by far the greatest, form of obstruction to traffic is the intersection of conflicting streams of vehicles. It is this almost entirely that is responsible for the crowding of streets, by holding up traffic every minute or so, and no improvement in conditions can be looked for unless this omnipresent defect is remedied.

Generally speaking, as soon as the volume of traffic at an intersection causes difficulty, a policeman is stationed there to fulfil the duties performed by a signal on a railway. This is well enough to prevent accidents, but otherwise it does nothing towards expediting traffic, and in fact may, and often does, hinder it. The system is adopted mainly for the safety of pedestrians, and the requirements of vehicular traffic are only distantly considered.

Given a relatively wide enough area of convergence, there is of course no intersection problem, and traffic moves at a sufficient rate. Take for instance the "Etoile" or the Place de la Concorde at Paris, which are amply large to accommodate the converging traffic. In London, again, much good has accrued by taking a large corner off Hyde Park, and throwing it into the road at Marble Arch. Where it is only from parks and such-like public spaces that roads and intersections are enlarged little harm is done—in fact much good results, because ground that was commercially waste before becomes commercially useful. And seeing that the very presence of a park in the centre of a town, without any arteries for traffic through it, is responsible for all the congestion on its borders, it is only reasonable that its boundaries should be docked where necessary.

The point to decide, however, is the necessary area of the intersection. More land than is necessary to allow the free movement of traffic is wasteful, less reduces the effective width of the streets concerned by causing congestion.

Taking as our standard a vehicle 30 ft. long by 10 ft. wide, its obstructiveness to cross traffic is twice its own length, plus the width of the crossing vehicle, *i.e.*, 30 + 30 + 10 = 70 ft., and the intersection area should therefore be enlarged to provide $\left(\frac{70}{30}\right)^2$ of the rectangle formed by the intersection, say 5½ times as much.

A simple approximate formula can be adopted for effecting this with the greatest economy by adding its own area

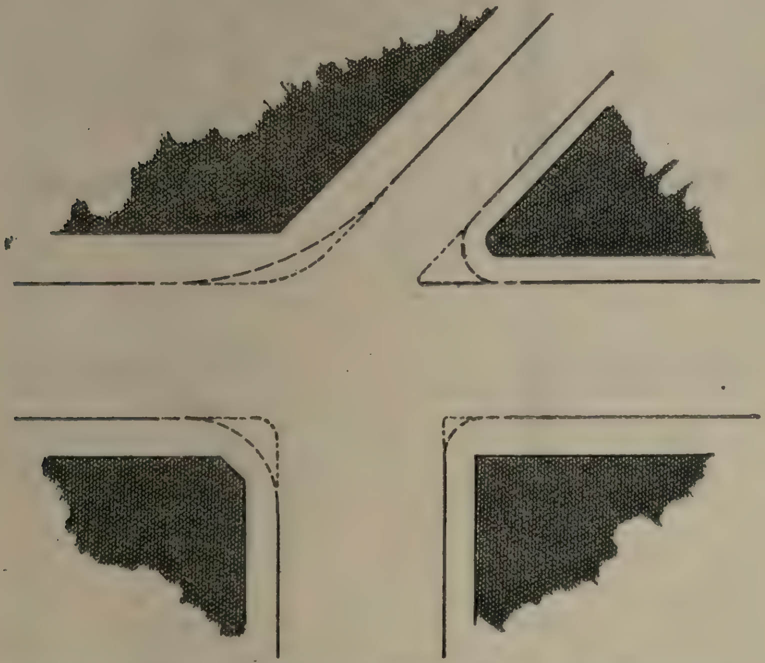


FIG. 1.—Plan of Intersections showing pavements rounded off to give the maximum of smoothness to deflecting traffic.

to an intersection. Thus if a street of 60 ft. intersects one of 40 ft. the intersection area required is $60 \times 40 + 60 \times 40 = 4{,}800$ sq. ft. The additional area of 2,400 sq. ft. is added to the roadway at each corner in rectangular intersections, in equilateral triangles of ¼ the area of the addition, and in irregular intersections according to their shape. For simple junctions, half the area would be appropriated and dealt with in the same way (Fig. 2).

If this principle were applied at all intersections at present where sufficient congestion arises to prevent traffic from freeing itself automatically, and instead of widening the intersection the roads were narrowed down to give the present area its correct proportion on this basis, the result would at once explain the inability of the roads to carry their traffic properly.

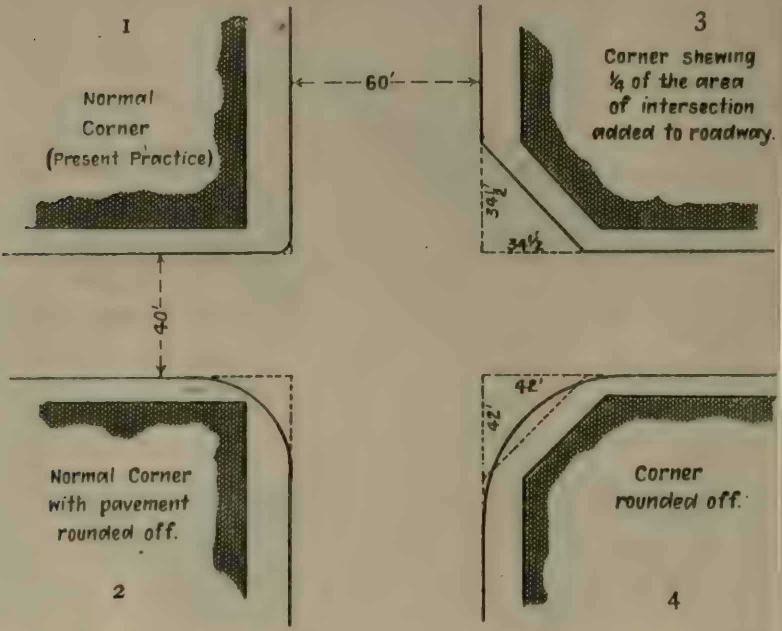

I
Normal Corner (Present Practice)
60′
3
Corner shewing ¼ of the area of intersection added to roadway.
34½
34½
40′
Normal Corner with pavement rounded off.
2
42′
42′
Corner rounded off.
4

FIG. 2.—Plan of an Intersection, 60′ × 40′, showing (1) the normal rectangular corner with scarcely any rounding off; (2) the corner rounded off to the maximum; (3) the increased road space required at each corner; and (4) the method of rounding it off.

For acute angle intersection, the space required is less than for rectangular, in proportion as the difference between angles increases. Apart from the vehicles requiring less room theoretically and practically to intermingle, if any angle is much less than a right angle, traffic will avoid that course, so as to avoid having to go back on its tracks. It is therefore possible in extreme cases to apply the entire accretion at the obtuse corners (Fig. 3).

To abolish the congestion caused by the intersection of streams of traffic, the gyratory system has been advocated,

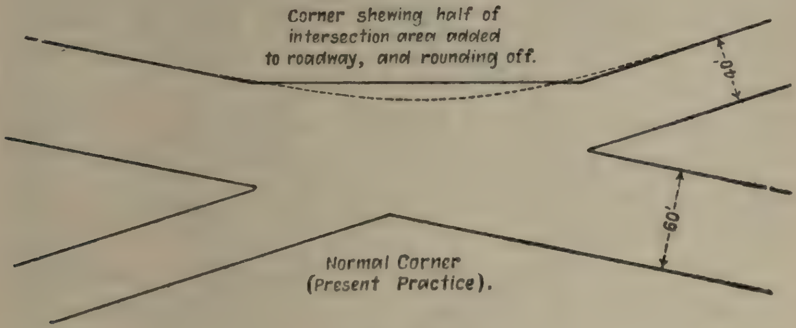

Corner shewing half of intersection area added to roadway, and rounding off.
40'
60'
Normal Corner (Present Practice).

FIG. 3.

and in the case of trams put into operation at the "Etoile" in Paris. This is the old idea of the "circus," such as appears in London at Oxford, Cambridge, and Ludgate Circuses, and so on, whereby it is intended that each vehicle shall turn in the one direction irrespective of its ultimate destination, and so avoid interference. Thus a vehicle coming from the north and proceeding west would turn (in England) to its left, that is eastward, and follow the circus round until it had passed through an arc of nearly 270° and reached the western road, making 270° of turning to effect a deflection of 90°, while a north and south going vehicle would describe 180° instead of adhering to its straight line (Fig. 4).

Traffic, as we have shown, moves in the line of least resistance, *i.e.*, in a straight line in preference to curves, and when curves are necessary, in as wide a curve as possible. Apart from the fact that the 90° curves on entering and leaving the circus are far too severe for easy traffic, the additional curvature required by this method is sufficient to condemn it, and it is not surprising therefore that the method has dropped into disuse for free moving traffic, the London circuses being cumbered up with all sorts of obstructions, and traffic moving in the line of least resistance as elsewhere.

For existing planning, however, other means of freeing the congestion have to be adopted, as the purchase of the necessary land for increasing the area is expensive, and often quite impossible.

Apart from reducing the width of the street in conformity with the standard suggested for the intersection, which may result in having to reduce the street widths so as to prevent the passage of even two columns of traffic, the only method remaining is to abolish the intersection altogether, by carrying one road over the other on a viaduct. As a remedy for congestion it has never been tried, but an example exists in Holborn Viaduct in London, which forms an interesting example of its effects on congestion, when the state of the Viaduct and Farringdon Street are compared at the intersection at Ludgate Circus.

The method is particularly suited for intersection where gradients exist in the roads, as these can then be done away with in the new plan, but even on the level the objections are not such as could prohibit its adoption. In the main, these resolve themselves into gradients, and loss of light and consequent depreciation of property where the gradient rises.

As to the first, the difference in road levels must be

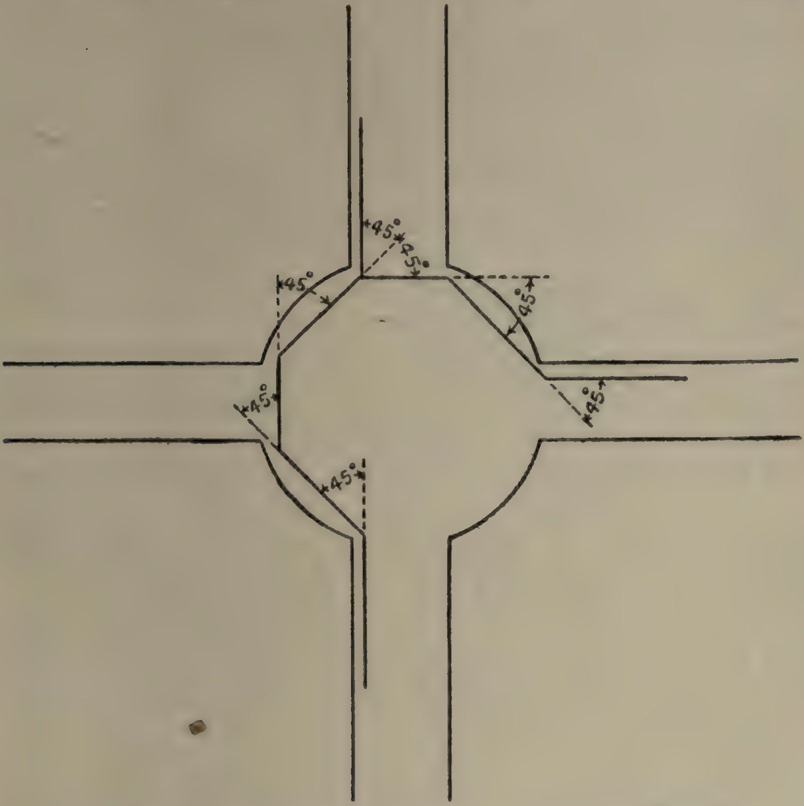


FIG. 4.—Plan showing the additional amount of deflection caused in a gyratory system.

assumed at not less, though it need not be more, than 20 ft., giving about 18 ft. of head room. On the average, the gradients for the over bridges must not exceed 1 in 10, while on the under roads a somewhat steeper allowance can be given. There is, however, not much object gained in steepening the under road, unless the over bridge is thereby lowered. In any case it would rest largely with the locality as to what levels were decided on, always bearing in mind that if the gradients are too steep, traffic will avoid the route and so create congestion elsewhere.

As to the depreciation of property, the only consideration would be loss of light for some 100 ft. on each side of the over bridge. This, however, is not a point of as much weight as the landowners would try to make out, because at present such corners are made the halts of an almost continuous stream of omnibuses, which block out the light quite as effectually as a viaduct would do.

There is, however, a further constructional problem affecting the scheme, and that is the provision for pedestrians to cross. As in all cases of traffic, our first consideration must be for the pedestrian; it is practically impossible to force him to deviate 100 ft. on each side of the road at every big intersection he comes to, while from a consideration of the existing householders it is absolutely impossible to carry the pavement up on the same level as the roadway, as that would actually prevent access to the adjoining buildings, and also stop pedestrians from turning the corner. In consequence the existing pavement must be left intact. The provision for the crossing of pedestrians at these intersections therefore involves some ingenuity of design, though it must not be forgotten that the over and under roads may be somewhat docked of their width, without suffering inefficiency, on account of the absence of houses on each side, and also because of the higher speed which would be adopted for getting over them. In fact, in the case of a wide artery, it might be possible to leave the one road on the old level, in which case practically every possible objection to such a method of dealing with the obstruction would be disposed of.

There is an additional traffic advantage attaching to this method of separation, quite apart from the obvious freeing of the cross courses, and that is its effect in distributing the load by forcing deflecting traffic to make use of by-roads instead of the arterial intersection, as would ordinarily happen, while the absence of such an intersection would convert a previously congested road into a comparatively empty one, so that at all minor cross roads traffic would find no impediment to moving out of the direct line.

This solution does not, however, serve for convergences, *i.e.*, where several roads meet at one point. This system, which unfortunately obtains credit almost universally, is the most fatal of all traffic arrangements.

Let us consider the conflict of currents at junctions, intersections, and convergences, and see how cumulative is the effect of each addition to the roads that meet. (In the future, "junction" will be used for where one road meets another, *i.e.*, a confluence of three roads; "intersection" where one road crosses another, *i.e.*, a confluence of four roads; and "convergence" for any confluence of five roads or more.)

In the case of a junction, there are only three streams which can possibly conflict. If another road is added and the junction made an intersection, there are eight possible conflicts (Fig. 5). Add one more road, and with a convergence of five roads chaos reigns with fifteen conflicting streams, which one of six roads makes a conflict of twenty-four (Fig. 6). Obviously, then, if eight conflicts are sufficient to warrant attention as is commonly enough the case, fifteen or thirty conflicts make the demand only the greater, especially

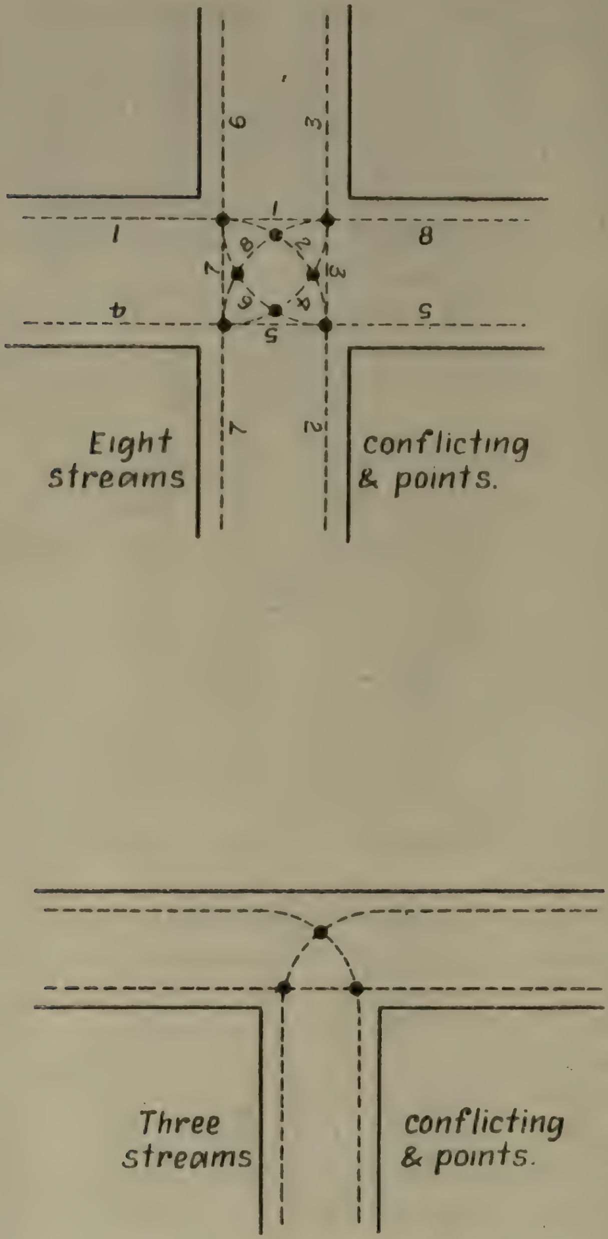
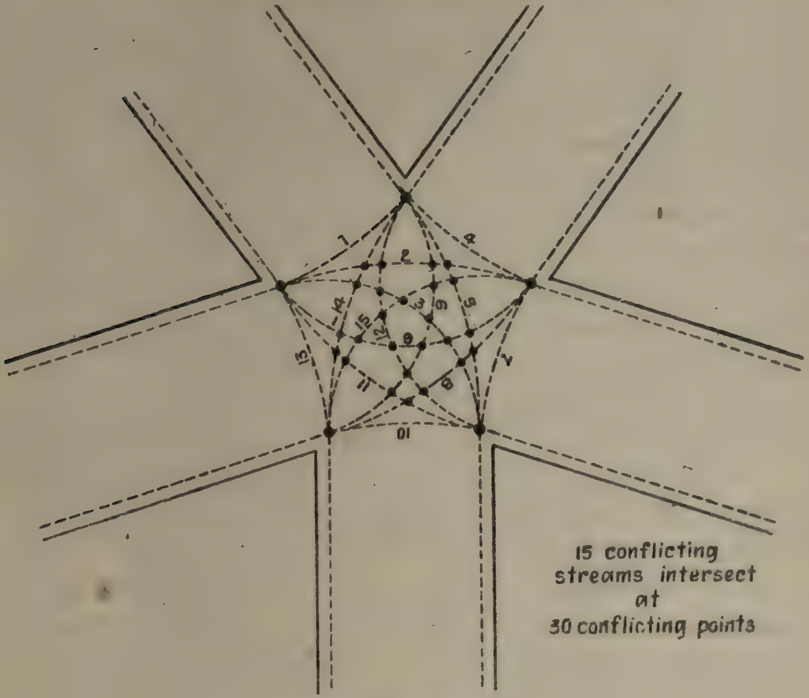

Eight streams
conflicting & points.
Three streams
conflicting & points.

FIG. 5.

when it is remembered that the relative increase of points of conflict is in still greater proportion, viz. :—

3 roads : 4 : 5 : 6
as 3 conflicting streams : 8 : 15 : 24
as 3 points of conflict : 8 : 30 : 84



15 conflicting streams intersect at 30 conflicting points

Fig. 6.

Of course it is not contended that in practice the ratio is in these figures, because as soon as angles of divergence less than a right angle are introduced, they tend to discourage intercommunication, so that with five or six road convergences there are always certain streets where the acute angle will hinder traffic, and so reduce the conflict.

As an instance of the evils of convergences, it was shown by count in London that the volume of traffic passing the Marble Arch, Hyde Park Corner, and Charing Cross was in each case greater than that passing the Bank of England, and as the congestion in London is greatest at the latter point, this fact created general surprise. A slight consideration will, however, show that the reason why the volume of traffic is greater at these points than at the Bank, is that it is a physical impossibility, on account of the varying directions of the streams, for more traffic to get through, and in confirmation of this it was also found that the aggregate time of the stoppages undergone by traffic at the Bank was considerably greater than at any other point taken. Did more facility for passing the traffic through exist, the volume there would enormously increase. It is merely held in check by physical limitations.

And yet in London all the newest roads—Queen Victoria Street, Shaftesbury Avenue, Aldwych—have all either added to or formed convergences, and so largely discounted their utility. Had the above principles been understood, this could hardly have happened.

If we take a convergence of six roads and divide it up by means of a kerb into two sets of three, we have in place of the former original twenty-four conflicting streams only six, viz., two sets of three. It is true that the three north roads, let us say, cannot communicate here with the three south, but what previously was an intolerable clot becomes comparatively free flowing, while the north and south traffic has to find its intercommunication elsewhere.

Dissociation of streams is a matter of prime importance in remedying traffic congestion. Unfortunately, owing to the practice of concentrating all our traffic facility into certain favoured roads, the by-roads are often inadequate;

but when traffic improvements are going to be taken in hand, it is more profitable to provide a by-road, which will permit of the splitting up of a convergence, than to widen the convergence area.

Often by the interposition of kerbs in certain convergences, it will be found possible to dissociate streams and hinder cross currents, to the consequent benefit of traffic ; but it must not therefore be thought that kerbs are in themselves a sound traffic principle. In the physiology of traffic they are a poison, which, in proportion as it is drastic, is harmful to the healthy body, though it may be made useful in suppressing a disease.

The most perfect traffic junction is when a road divides into two, which diverge at less than a right angle with each other, a narrow "Y." This results in there being not three points of conflict as in an ordinary rectangular junction, but only one, as there will be no traffic between the two branches; this same virtue attaches to oblique intersections (Fig. 7).

There still remains the consideration of the actual width of road required for the normal conducting of traffic. Street widening is generally spoken of as the only cure for traffic evils, but as generally undertaken, it is entirely ineffective, and does very little towards the permanent improvement of traffic, because the attractiveness of the road soon draws more traffic to it, and the situation is in no way improved. Widening, further, has the disadvantage of not being operative, unless the width is constant throughout, because the capacity for traffic of a road is limited to the width of its narrowest part.

It is a matter of far more importance that road width should be judiciously disposed than that it should be very great. In most towns, as we must admit, the total width of the streets is more than ample for the traffic, but an overwhelming percentage of that width is never used. It is the equalisation of the load factor of roads that must be attempted rather than, as now, its differentiation, by devoting all the energies to a few selected arteries.

The question of the necessary width of streets is not properly understood. It is, of course, impossible to lay down hard and fast rules for this, but there is a principle absolutely universal applying to it, namely, that "a road should be kept as narrow as is compatible with the volume of traffic it has to carry; in opposition to the general idea that a road should be made as wide as the land for it can be obtained. To put it otherwise, the requisite width of a road must depend on the house density of the district, and normally requires to be no wider than that. Arterial roads will, of course, require greater width than local ones, irrespective of house density, by the width of a double stream of traffic, but under a proper system of planning, arterial roads would become less and less pronounced as the load factor of the district became equalised. It is not fully recognised that it is quite easy to make roads far too wide from a traffic point of view. On the Continent, many such cases can be cited. In a town the effort of every one is towards concentration; it was concentration of business and residence that led to the formation of towns. Now a road occupies space in the town, and a road of 100 ft. in width occupies just twice as much space as one of 50 ft., and opposes this desired concentration. The main factor of all traffic is the individual, and the primary movement of the individual is on his feet. If we were to convert Cheapside into a Champs Elysees, and Mansion House Street into a Place de la Concorde, the virtues of the city of London as a business centre would be considerably

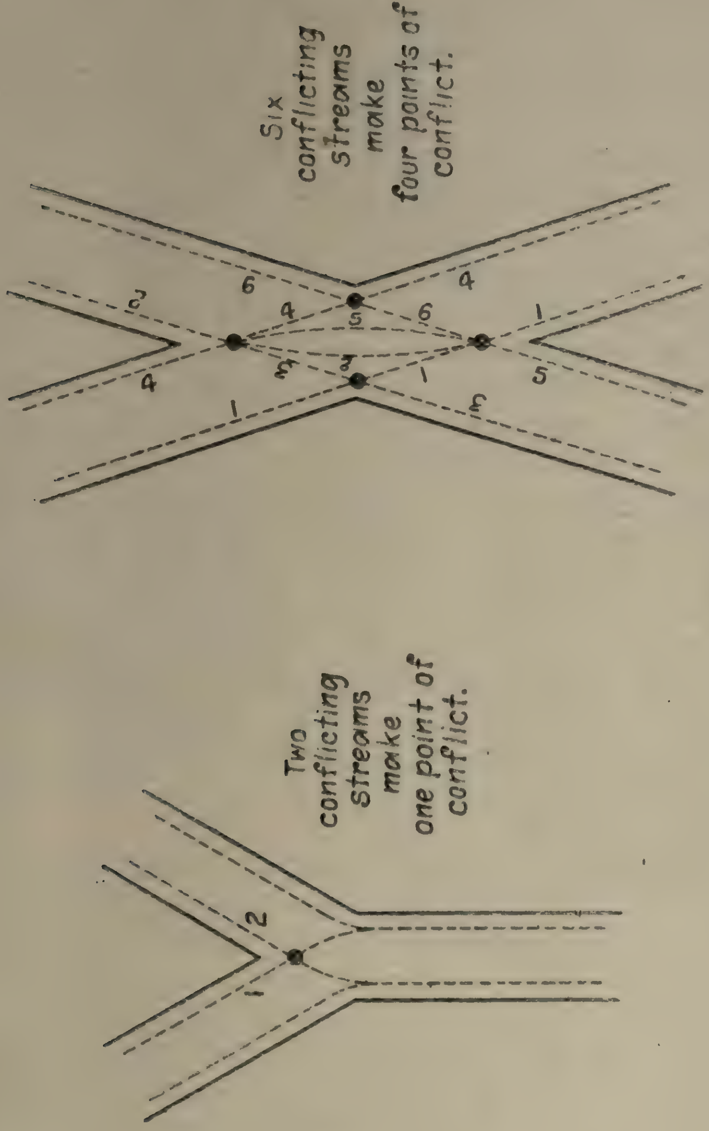

Six
conflicting
streams
make
four points of
conflict.
1
2
3
4
5
6
Two
conflicting
streams
make
one point of
conflict.
1
2

FIG. 7.

lessened. The only means, therefore, of economically improving street conditions is by a system of equalising the varying load factors of the roads.

It has been mentioned that one large source of congestion in towns is the presence of large open spaces—wastes, from a traffic standpoint—in the shape of parks, rivers, etc. With a normal house and population density, residential districts should present no traffic problem at all. That they do is generally due to the presence of large trafficless tracts, the presence of which cause vehicles from districts beyond to deviate, and as this traffic seeks the shortest road, it naturally skirts these areas as closely as possible. In London, for instance, there is practically no traffic congestion in Belgravia, outside the one or two points abutting on Hyde Park ; but Mayfair, with Hyde Park and Green Park restricting its outflow, suffers very severely on their borders ; though practically nowhere else. In fact, it may be admitted that in residential districts of good class, there can never arise any traffic problem ; in business areas, the desire for concentration overrules all other considerations, and so we get excessive house density, which, even though only temporary as in most business quarters, affects the traffic conditions just at the period when its facilities are most required.

The question of housing is, in fact, so closely bound up with traffic that some attention must be given it here, more in the nature of emphasising its bearing on it, than to lay down any laws. It will be obvious to anyone who considers the matter that the erection of a building to accommodate many thousands of persons is bound to affect the conditions of traffic in its vicinity, generally unfavourably. The congestion of humanity arising in houses of entertainment is generally recognised, and in general, steps are taken governmentally to counteract the possible evils that may arise from such within the building. Numerous exits, etc., are demanded, so that the people within can leave rapidly in the event of an accident—bitter experience has taught us the necessity for this—but once the people are cast on the street, no further provision is made for their progress; they are left to seek their own salvation, and this entails some effort on a wet night. Again, in America, huge "sky-scrapers" of enormous accommodation are erected without the slightest regard to the possibility of bringing people to them or of taking them away. Housing, as a science, has devoted itself purely to the sanitary aspect; in future it will have to consider the traffic aspect also. Then when traffic has become a scientific study, the authorities will consider the plans of a building from their bearing on traffic as well as on health; and then, and only then, possibly congestion in towns will be kept in check.

CHAPTER IV

ROAD SURFACE AND CONSTRUCTION

How Roads are Formed—Need for a Stable Surface—Paved Roads—Roads should be Utilised for Full Width—Sides more important than Centre for Efficiency—Reverse obtains in Practice—Effect of Mixed Paving—Ideal of Surface—Repairs—Time a Maximum Factor—Half-Street Repairs.

It has already been pointed out that the attractiveness of a road is a very great factor in traffic, and we will therefore now consider what is the ideal to strive for in road construction.

First of all, the road should be as straight and as level as possible, and afford a safe passage in all states of the weather. Few town dwellers appreciate the true value of roads, if they have never been along an unlighted road in the country on foot; if they have not lived in a newly developed district, where roads consist of wide mud tracts, or in hill country, where they might better be described as paths, and where the question of safety is brought home to them in a way never otherwise experienced. In towns, however, this phase is seldom met with; roads become streets, well lighted and paved, and protected by police at all points. But inasmuch as the road is the forerunner of the street, it will be well to consider the question from the original point.

Generally speaking, prior to the formation of a road, there is some track or path—usually no more than sufficient to accommodate the pedestrian or rider. When wheeled traffic becomes imperative, the path has to be widened, and so the road is formed. Gradually as traffic grows, gradients perhaps over-assert themselves, and their steepness is reduced. Then the inconveniences of an unstable surface, alternating between dust and mire according to the state of the weather, are experienced, and attempts are made to render it constant by the overlaying of some hardening material. This improvement is, however, of very recent date, and before Macadam's time may be said to have been non-existent. As an instance, in earlier days all military operations used to be suspended in winter time on account of the state of the roads, which precluded the movement of heavy material.

Macadam's principle was to cover the road with a surface of finely broken granite, which gradually became homogeneous, and resisted the destructive effects of weather and traffic, and his principles are still the main surfacing of our roads. Such roads cannot, however, sustain the strain of very heavy traffic, such as is met with in busy streets, and so paving of various kinds has come into use, of which the best examples are asphalt and wood. These pavements are costly to construct and necessitate a concrete bed on which to lay the paving, but the resulting surface is so superior that the gain to traffic more than compensates for it. Owing to the impermeability of such roads, the camber for drainage purposes can be enormously reduced, and the accommodation is thereby proportionately increased. In a macadamised road, it is not practicable to build with less than 1 in 25 camber on the average, and in practice unfortunately it is frequently more, so much so that high speed vehicles always hug the centre of roads through fear of skidding on the steep side slopes. The same tendency is natural to all traffic irrespective of camber or speed, so that it becomes a matter of considerable importance not to encourage such a reasonable waste of the road space.

As a matter of principle, the sides of a road, of whatever material composed, should be superior to the centre; in practice the reverse is the case. In all but the most extremely congested roads it would be advisable to keep a strip of inferior surface in the centre, say 10 ft. wide, in order to encourage traffic to keep to the side and leave passing room. Thus an asphalted or wood-paved road, with a strip of granite setts in the centre, or a macadamised road with cobbled centre, would tend to cause traffic to economise space, without causing hardship to any user. But in that case the sides of roads would have to be kept in a far higher state of efficiency than at present.

The ideal surface is one which combines homogeneously, wears evenly and slowly, is stable enough to resist climatic influences, soft enough to allow good footing for horses, while hard enough to resist attrition and its attendant mud and slipperiness. Such a standard does not at present exist, though possibly in some substance, such as rubber, may be found the necessary qualifications, as soon as the price enables that commodity to be used for road building.

Intimately connected with the subject of road construction, is that of road repairing, and it is in this respect particularly that the paved road so outshines the ordinary consolidated road. For urban work the paved road is in any case superior on account of the reduced friction it offers to traffic. This, however, is of minor importance when compared with the reduction of time that it requires for repairs, due to its greater durability.

All the time that a road is under repair, it is causing obstruction to traffic, in proportion to the closed area, and is entailing on it a very heavy cost, none the less actual because not mensurable. If this waste can be avoided, a great deal is already gained.

A road paving that requires less repairs than another, that will carry its traffic with the least deterioration, is therefore the material to strive for, irrespective of its disadvantages in other respects, such as cost, etc. If, for instance, a paving can be laid down or repaired in the course of one night, so that the road is ready for traffic the following morning, such an advantage would outweigh any considerations, such as the tendency to slipperiness that is inherent in asphalt when slightly wet, while the additional cost is fully though invisibly recovered in the general gain to traffic.

Yet how often do we not see half sections of the busiest roads taken up for repairs, concentrating all the traffic on a bottle-neck for several weeks before the repairs are completed. With a macadamised road this half section method has the further disadvantage of entailing a serious constructional fault, as it is almost impossible for a road so built to consolidate evenly, while it also tends to raise unduly the crown of the road. For a busy road this method is entirely wrong and a false economy. Irrespective of the method of paving, if the whole street requires repair, the whole street should be barred to traffic, thus enabling the time occupied in the repairs to be considerably shortened. Traffic is then diverted to the side streets at the barrier, and rejoins the main road past the next barrier. Such a deviation saves infinitely more time to all concerned than a system of driving traffic into a bottle-neck.

Speed in repairs, as in all other matters of traffic, is the vital factor, and to attain this a certain amount of inconvenience is permissible while they are in progress, but there is no need to inconvenience more traffic than is absolutely necessary, and in the case of barring a road, the only portion of traffic seriously hurt is that which is absolutely blocked from the houses fronting the repairs. Their contribution to the general traffic of a busy thoroughfare is very small indeed.

CHAPTER V

THE RULE OF THE ROAD AND ARTIFICIAL REGULATION

Need for Uniform Behaviour—Rule of the Road—Definition and Explanation—Cross Course Rule—Artificial Noise—Economy of the Rule of the Road—"Wrong" and "Right" Side of the Road—Furious Driving and Wilful Obstruction—Relativity of Traffic—"Slow" and "Fast" Traffic—Reductive Effect of Dividing Roads Arbitrarily—Central Obstacles—Coercion of Innocent Roadfarers should be Avoided—Functions of the Police—Regulation at Intersections—Possibilities of Dispensing with Police Control—Traffic should be Self-Regulating — Effect of Police Interference in Traffic—Permanent Necessity for Police Control—How Applicable.

Even assuming our town perfectly scientifically laid out and paved, no traffic could be conducted without some pre-agreed attitude on the part of each vehicle towards the others. All road users (except trams) theoretically are free to move in any portion of the road, free to stop when they choose, and free to proceed at any pace that suits them. They are not confined like railway trains to isolated tracks, controlled by signals and other mechanical devices; therefore there must be some simple rule, of which the observance by all will be universal in its application to the facilitating of traffic. This may be termed the "Rule of the Road," and in England may be defined as "Always keep as far over to the left side of the road as you can." It matters not whether the prearranged side is the right or the left: the principle is the same in its action if only it is strictly observed. Coupled with this, and of equal importance in traffic, is the golden rule of behaviour:—"Do unto others as you would they should do unto you." The observance of these two rules then leads to certain corollaries as to right of way, which are:—Right of way lies with the vehicle in front, and at junctions with the vehicle proceeding in a straight line.

At intersections we are, however, faced with a difficulty as to which vehicle has right of way, when courses cross each other. It is generally assumed that the main road should have right of way over the subsidiary, but such a rule is altogether too loose in practice. What is a "main" as distinct from a "subsidiary" road, and how about the intersection of two main roads or two subsidiary roads? And how are drivers to know which class of road they are on, especially at night?

It will readily be seen that such a rule really brings us no farther forward as regards the prevention of misunderstandings, though it would no doubt help in the legal fixing of responsibility after an accident. Accidents, however, are not traffic.

A very simple rule can, however, be formulated, which definitely fixes right of way, as follows:—"On cross courses a vehicle meeting another vehicle on its right must give way." This operates automatically, from any and all points of the compass, and its worst effect in the case of misunderstanding would be the stoppage of both or all the vehicles.

These rules should then be printed on every vehicle licence, so that there could be no pretence of ignorance on the part of the driver. At present, though ignorance does not excuse, it does account for a great deal of the difficulties caused, which we are better without.

Proper adherence to these rules, for instance, renders the sounding of a horn or other instrument of noise to notify one's approach not only unnecessary, but an absolute nuisance, instead of a requirement, in driving a motor car.

Traffic should seek to move as speedily along the arteries as it can; if not, the effect is to reduce the capacity of the roadway. As for noise, traffic makes quite enough of that in its ordinary movement, without adding artificial instruments for that purpose. Should a vehicle be so silent that there is danger of running over pedestrians, a small bell so hung as to give a continual sound, audible for three or four yards or so, is sufficient to prevent accidents with careful driving, without which no amount of noise, however weird and offensive, will give immunity.

To revert to the golden rule of traffic, and follow its perfect operation, it will be seen that vehicles moving in opposite directions keep on opposite sides of the road, and the central position is left bare. Assuming that the road will accommodate five rows abreast, two rows of vehicles will be able to proceed in opposite directions at varying speeds without in any way interfering with the other. When, however, a third row is introduced on both sides, it is obvious that passage is prevented, and one of the third row vehicles will have to give way to allow the passage of the other. If they did not do so, one or the other vehicle, or possibly both, would be guilty of obstruction or furious driving; they could not exonerate themselves by pleading that they were as far over to their side of the road as possible.

In optional movement of this description no definite limits can be laid down. Numbers of people speak of a vehicle which is beyond the physical centre of the road as on the "wrong side." This is not so if the vehicle is overtaking another as closely to it as is reasonable, and there is room for it to pass, as far as opposing traffic is concerned. If, however, this vehicle comes into collision with traffic meeting it, which is also observing the rule to keep as far over to the side of the road as possible, the vehicle is guilty, not of being on the wrong side of the road, but of driving furiously. Everything in road traffic is relative—speed, position, and so on—nothing is absolute; and in a case where our typical five abreast road was destitute of up traffic, the fifth row of the down traffic would be quite on the right side of the road, if passing four other vehicles abreast, though its position would necessarily take it close up against the right-hand kerb.

And again, some persons try to lay down rules of traffic, whereby slow vehicles keep to the side of the roads and fast ones to the centre—a misconception, which can lead only to inefficiency. At what rate does fast traffic move? And at what rate slow? Is 5 miles per hour slow? Yes! Is 7? Yes! Is 9? For a motor car, yes, but for a horsed vehicle, no! And, looking ahead a few years, when the normal and possible road speed will have increased enormously over that in pre-motor days, and there are three cars moving along in the same direction at 20, 30, and 40 miles per hour respectively, the latter car will call the first slow, and want him at the side of the road, and yet it cannot be called slow according to our present lights, when as fast traffic he would be entitled to the middle of the road.

No! There is but one rule of the road if things are to go well, "Keep to the side"—lorries, cabs, 'buses, motor cars, bicycles—and only come out into the middle when you want to pass some slower—but not necessarily slow—vehicle.

In this way the road is made of maximum utility, and is able to expand to its full limits. Any form of central obstacle is therefore directly opposed to the rule of the road, by dividing it into halves, and thereby attempting to form lines for the traffic In example of the fallacy of this theory, the five abreast road under possible circumstances is reduced to two abreast, while normally and as favourably as possible it is reduced from five to four.

It is worth while to consider the point very definitely, as central obstacles are on the increase, and their effect on traffic should be fully realised. With a central obstacle, permanent or temporary, whether in the middle or somewhat to the side of the road, the vehicle has to clear it with its off wheel, and has also to clear the kerb or vehicles on its near side with its near wheel. If the vehicle is allowed to pass the obstacle on its far side, there is a similar lack of flexibility and accommodation. An obstacle is therefore equal to its own width plus the width of any vehicle avoiding it.

This degree of obstructiveness applies to longitudinal traffic only ; if deflecting traffic is considered, it will be seen that the obstructive effect of a central obstacle placed within the deflection area is increased, because it reduces the natural area of deflection and makes the angle of deflection more acute. It has been pointed out that the maximum angle of deflection for traffic should not exceed 45°, so that if obstacles are placed within that angle of a corner they prevent traffic from deflecting as early as it otherwise might, and then cause it to deflect more sharply, with of course less consideration possible for the other traffic. If it is desired to avoid this, no obstacle must be allowed within 45° of either corner, in which case no additional obstruction is placed on the deflecting traffic (Fig. 8).

Inasmuch as all road traffic is optional, no coercion of those who are observing the rules is justifiable, and the artificial regulation of traffic by police, which consists of stopping it from time to time, shows that something is wrong with the physical state of the arteries of traffic. The policeman is the maintainer of law and order and is not a signalman. His energies *vis-à-vis* traffic should be devoted to arresting delinquents—not to arresting the course of innumerable innocents.

Two wrongs cannot make a right, and if it is the roads that are wrong, as in all present cases, they should be put right, and no further injustice inflicted on the innocent users of the roads.

In civilised countries, roads are for the sole purpose of traffic, and anything which prevents this from being carried on, as does any form of obstruction, is wrong fundamentally. The coster with his barrow, the stationary cab, and so on, are not allowed by the police to obstruct traffic, but the police themselves are!

In general, and probably not without justification, the police have a great deal lower opinion of humanity than humanity has of them. This is hardly avoidable, seeing that the police are constantly brought into contact with the inferior side of human nature. They therefore are led to believe that the average pedestrian is unable to cross the roads without being shepherded across, and that the driver cannot be trusted to find his way across an intersection by himself for fear of getting himself and all the other traffic involved in an inextricable tangle: and so he too is held back and sent forward in droves.

The method has much to recommend it in one respect, as it avoids danger to pedestrians at such points, and at least secures the ultimate passage of the vehicles. But as a means of expediting traffic, it is seriously deficient.

In an inadequately planned intersection, obstruction is bound to occur, whether by entanglement or police stoppage, as soon as the street feeding it provides too much traffic. It is, however, possible to reduce the obstruction to a minimum by the adoption of a more scientific road lay-out, which would dispense with police control, and yet ensure non-entanglement in all but very serious cases.

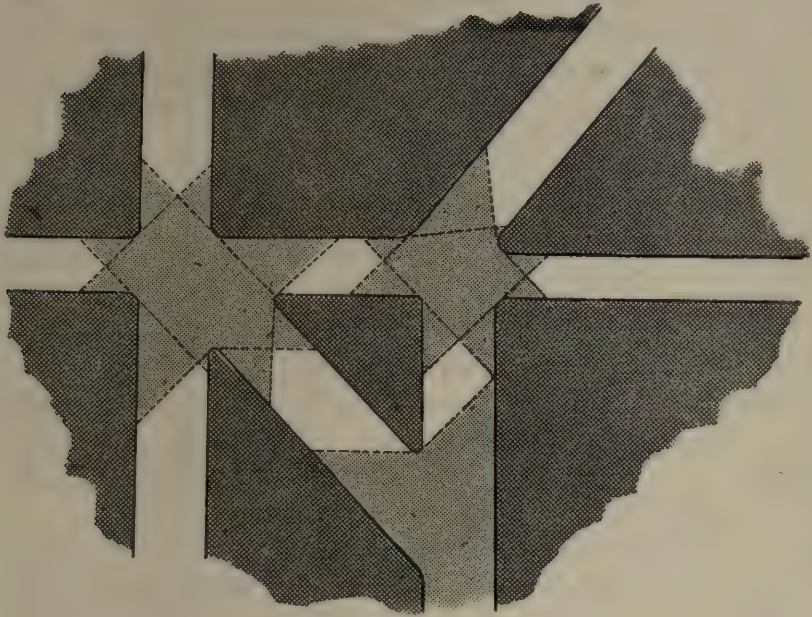


FIG. 8.

The causes of entanglement in the main are unevenness in the volume of traffic, whereby at certain times the intersection area becomes inadequate for the traffic surging into it, coupled with the selfishness of drivers in all wanting to get through at once. If only the flow of traffic into an intersection can be restricted to a certain maximum, no entanglement can occur. The police now effect this by closing certain streets for certain periods, but a similar restriction would be exerted by placing a kerb in the roadway, so as to allow only one column of traffic to pass into the intersection area from each road. No restriction is of course placed on vehicles passing out of the intersection.

The capacity of each road for feeding the intersection amounts to some thousand vehicles per hour, at 6 m.p.h., which is more than sufficient for most intersections. With two 60-ft. roads intersecting, there could be a width of six columns of vehicles in the intersection, which normally should allow for free interfiltration. The congestion arising from the inadequacy of the intersection area would then occur in the streets longitudinally before reaching the intersection, and no police guidance would be required at such points, while the period of delay should be greatly shortened (Fig. 9).

The practical effect of this principle is to prevent more than say fifteen vehicles a minute—sixty in all—from entering the intersection, while the continuous access provided in place of the intermittent gives a higher degree of all-round efficiency.

The automatic nature of this control is apparent if we consider it as applied to various widths of roads. Four 20-ft. feeding roads give an intersection of only 20 ft. × 20 ft. = 400 sq. ft., while the bottle-neck is actually half the road width, in other words, disproportionately wide. On the other hand, owing to speed variations, standing vehicles, and cross roads, a 20-ft. road cannot pass very much traffic, certainly not up to the maximum of 4,000 per hour. When a 40-ft. road is considered, it may easily pass a large volume of traffic, but then the intersection area is also increased from 400 sq. ft. to 1,600 sq. ft., which is

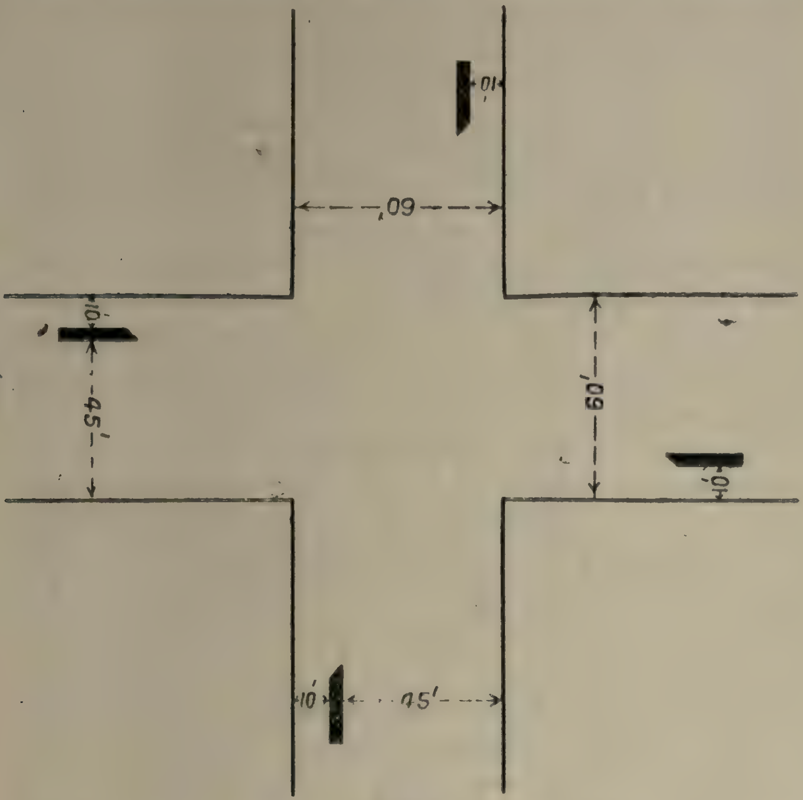


FIG. 9.

still fed at a maximum rate of one vehicle per road in each four seconds. On the other hand, it is possible that even thus the congestion might be too great, but there is nothing in the principle which precludes the possibility of police control on the intermittent system in addition. It is apparent that it is impossible to restrict the bottle-neck to allow less than one column of traffic, and so for a very small intersection fed by exceptionally large streams, some system of intermittence might be required in one or more of the streets.

As intersection areas increased in size, it might be found possible to enlarge the bottle-neck in one or more of the streets to allow of two or more simultaneous columns of traffic to come in. This, however, is discoverable only by trial, as the exact relationship of street width to intersection area depends on such variables as the skill and unselfishness of drivers and the angles of the intersection.

All road traffic should be self-regulating, so that merely by the exercise of ordinary care on the part of its components all goes smoothly. If congestion and obstruction occur, trace them to their source. If this is found in the human being, prosecute the delinquent; if it is due to insufficiency of road, correct that. The operation of the existing laws is quite sufficient for the maintenance of traffic in proper order, and all traffic should be treated as amenable to the same laws. If the motor car has to carry certain lights, so too should the carriage, the cart, and the bicycle. As for speed restrictions, they are unnecessary and unjust, and their tendency in operation has been to cause the driver to imagine himself free from all blame, if he was not transgressing some special law. Free moving traffic cannot be classified as railway traffic is, and any attempt at class legislation is bound to defeat itself in the course of a short period of operation.

The tendency throughout the world at present is to restrict the responsibility of the individual, and this is particularly exemplified in traffic matters. This has caused in England special legislation affecting motor cars; and to the provisions of these Acts much of the public dislike of these vehicles can be attributed. Were it not for the "audible notice of approach," furious driving would be almost impossible on account of its danger, not only to the public but to the driver. Were there no speed limit, and a sane man allowed to use his discretion as to a suitable speed for driving, much more moderation would be shown by motor drivers, and fewer accidents would result.

Again, in order to keep traffic to the side of the road, the authorities obstruct the centre, and so on. The obvious result is to make the existing congestions worse. When a street becomes so crowded that speed is impossible, it is time to remove obstructions, not to create fresh ones. That this is partially realised may be the cause of having living instead of inanimate obstacles in the shape of police, who are stationed in the middle of an otherwise clear road, presumably to control unruly traffic and keep it to the sides, or in its proper place, wherever they may think that to be; to perform, in fact, the work of an inanimate structure with something of the majesty of the law in reinforcement.

The policeman, even in traffic, has a much higher function than that. We have shown that as little of him is wanted as possible, but there are occasions—and always will be—when his presence and control is necessary.

For instance, it is especially desirable that no obstruction should be allowed at points of intersection, within an angle of 45° from either corner. If a cart wishes to unload at a corner, it must be moved on, just as is the undesirable pedestrian by the police. As it will be long before this simple maxim becomes the general practice, police will be required for its proper observance.

Again, for public functions and so forth, where owing to a great concentration of vehicles waiting for the arrival of a certain hour, such as the closing of a theatre, or to the barring of certain roads on account of state processions, etc., he will always be a necessary feature. And so the function of the police in regulating traffic when required must still be considered.

If it is assumed, though there seems little likelihood of it, that in time permanent central obstacles to traffic will be removed, what then must be the behaviour of the policeman? His first care must be to cause traffic to move more smoothly by his presence than in his absence. Certainly this cannot be done if he stands in the roadway. There he takes up room, and is, as has been shown, an obstruction to traffic. As long as he wishes to be this, that is, as long as he wants to stop traffic, of course his position there is quite suitable, but as soon as he wishes to let traffic pass again, he must retire absolutely from the roadway. This is the very simplest way of communicating with the public, and it enables him to exercise the maximum of help with the minimum of obstruction. Yet how often is this attitude of helpfulness disregarded? On the Continent of Europe, and among Eastern administrations — controlled for the most part by Europeans through native constables—the ideal of the police is to regulate traffic by coercion, without a tittle of consideration for the traveller and for the physical danger incurred by both parties by their action. That the police in London have such a high reputation in dealing with traffic, both among visiting pedestrians and the resident road-users of all kinds and classes, seems to show that the necessity for sympathy and helpfulness at least is realised by them to an extent unknown elsewhere.

As long as it is well borne in mind that the driver is a free agent, and as such to be held responsible for his actions, all forms of repression are useless and only defeat themselves. Unfortunately, this has not been realised by the authorities, and so the battle has been too often to the momentarily stronger, until reaction and legal repression has followed, and reduced all giants, whether tyrannous or not, to the same level.

Of course it will be argued that these contentions are very delightful in theory, but unfortunately unattainable in practice, because on the "line of least resistance" theory, the overtaking vehicle will not trouble to edge in to the side of the road, as its driver knows that it will have to move out again presently when overtaking the next. This rebuttal is, unfortunately, only too true—humanity is purely selfish in spite of all the socialists in the world—and this weakness on the part of humanity is the only reason for the advocacy of that strip of inferior paving in the centre of the roadway, which, by pandering to human nature, encourages it to do right rather than prevents it from doing wrong; which should be the aspiration of every one who tries to deal with such fickle material.

CHAPTER VI

PASSENGER VEHICLES

Private Vehicles—Public Vehicles—Relative Efficiency—Actual Efficiency—Special Treatment of Trams—The Rail, its Effect, Reasons for, and Drawbacks—Confession now of Inferior Road Surface—Cause of Trams—Reasons no Longer Valid—Tram's Traffic Requirements—Clear Road Essential—Inferior Road Paving of Tramway Space—Inter-exclusion of Tram and 'Bus—Superiority of the 'Bus—Necessary Continuance of the Tram—Width of Road where Trams ply—Position of Rails—Position of Halts—Effect of Tram's Disobedience of the Rule of the Road.

We now come to consider the various components of urban traffic, and their general effect. Broadly speaking, passenger vehicles resolve themselves into two classes, private and public. Of the latter there are two kinds of vehicles in common use, the 'bus and the tram, while in the former come all the other vehicles, which do not ply on definite routes.

Of private vehicles there is not much to be said, they are free lances and come and go whither they list, and as the first comers chronologically, they have the right of way over the later specialisation of the 'bus and the tram. But it must not be lost sight of that they are comparatively very inefficient on the road, in that practically none of them have accommodation for more than four persons. Their special virtue lies in their speed and comfort, the private vehicle always being normally faster than the public, and having the superior comfort of taking you from door to door, such as hardly ever is the case with a public vehicle.

When, however, we come to compare their general traffic efficiency with that of public vehicles such as the 'bus and the tram, it is seen at once that with a comparatively small increase of road occupation, the capacity of the vehicles is enormously increased, while the economic result of this concentration is that travellers can be carried at a fraction of the cost for a private vehicle.

Consequently, the cry is always for more of these facilities, until these public vehicles have come to form more than half of the traffic of our streets.

The first consideration in a public vehicle is its road efficiency. It must carry as many persons as possible on a given area of road occupation. In proportion as this is done, so can its superiority in efficiency be determined. In such concrete matters as speed and area of road occupation, the result is absolute and definite; a vehicle carrying, for instance, ten persons on 200 sq. ft. at 9 m.p.h. is equal in efficiency with one carrying fifteen on 400 sq. ft. at 12 m.p.h.

If the area of occupation of a carriage or cab, holding at the outside four persons, is compared with that of a horse 'bus, the difference in efficiency is easily appreciated; assuming that the cab moves half as fast again, and occupies only two-thirds of the space, the ratio of efficiency would still only be as 9 to 26.

This rule, however, does not apply to trams, which cannot be gauged by the same laws as free-moving vehicles; and as the use of the tram is extending throughout the world, some consideration of its special attributes must be taken, in order to appraise its value.

Hitherto, the actual superiority of the tram in traffic has, for the most part, been questioned by those responsible for its introduction; and certainly in the past there is no doubt that in practice, whatever the theory, they had right on their side, in that the tram was the most road-efficient vehicle in existence, with a capacity of nearly three 'buses and a speed of at least 50 per cent. higher. This, which was realised under electric traction, was more than a sufficient set off against the great reductive element of the tramway, the rail and its fixed course, and caused the great development of this means of transport.

But the rail remains! This it is, and this only, that is the essence of the tramway problem, and the bone of contention. It is the rail that reduces wear and tear, vibration and traction costs, and by the accuracy of its laying enables such a huge machine to be run on such a slender base.

It is this primary fact which is overlooked so frequently by would-be critics of the principle; for the tram principle has nothing to do with the motive power; it is merely the principle of a small strip of as nearly perfect a road as possible specially reserved for a specially favoured class of vehicle.

And now we come to the other side of the picture. In retaining these few inches of perfect roadway, unfortunately it monopolises all the four feet or more lying between the rails; this has to be reserved for it too, although the roadway there is not used by it. More than that, the rails create an absolute obstruction to other traffic, and if placed in the centre of the road at once divide it into two equal parts. Further, they prevent the tram from conforming to the demands of other traffic, and obeying the rule of the road, and in breaking the rule themselves unfortunately cause others to break it too.

It is not easy to assess definitely the congestive effect of the tram, and great difference of opinion exists as to the degree of its influence.

The reason for this diversity of opinion is probably that it is lost sight of that the congestive influence of the tram varies inversely with the width of the road; that is to say, the wider the road, the less the tram's influence and *vice versâ*.

As to the maximum degree of its congestiveness, we can assume it to be in a road where it leaves room for only one column of traffic on either side. In such a case, it will reduce the average speed of every vehicle, itself included, in the ratio of the normal speed of the tram to the normal maximum vehicular speed.

Thus assuming a maximum vehicle speed of 20 m.p.h. and a tram schedule of 10 m.p.h., the speed of the 'bus will tend to be reduced to $\frac{10}{20}$ of 12 m.p.h., the tram from 10 m.p.h. to 5 m.p.h. and so on. As the street grows wider, the speed of vehicles is allowed more often to attain its maximum, and so the average speed increases.

In practice, therefore, at least 15 ft. (or two tram widths) should be added to the road width, if the existing traffic is not to be harmed. A 40-ft. road should be widened to 55 ft. if trams are to be installed, or congestion will be largely increased. It is a common cry in London that all the outlets are congested. This is undoubtedly so, but the congestion is all caused by the trams, and if these were removed the existing roads would be found in practically every case to be of ample width.

If any reader doubts the obstructive effect of the tram line, let him cast his thoughts back to the time when trams were not, and imagine the internal combustion motor duly invented. What would have been the result? Motor cars galore just as now, with an outcry for better roads just as now; and then let some authority or inventor, with the idea of solving the difficulty of the bad roads, suggest the tram rail, and see how he would be treated. The fact is that the rail is only suitable for a special class of traffic, and though it is, for such, the economic solution of the means of transport, it is utterly unsuitable for combination with other forms of traffic. Consider the rationale of the idea: given a road, un-made and unpaved, simply a path or right of way; primitively planks would be laid down, as is still frequently done in building operations, etc., to allow for economical transport. Gradually as the strain on these became heavier, steel rails and small cars would displace the earlier boards and barrows. This, however, would be of no use to persons wishing to traverse the distance, and so alongside of the rails would be made a hard road for the use of ordinary vehicles. This is legitimate tram practice; the reservation of its route to itself, and the separation and specialisation of two entirely different classes of traffic.

But in urban practice this cannot be; the tram lines and the vehicles are constantly being interfered with, and interfering with one another.

Theoretically, then, the tram has no right to exist, but practice cannot be gainsaid. Trams exist, and by their very universality have a right to be considered.

The upspringing of trams was primarily due to the desire to reduce passenger traction costs, which on the then inferior roads was a serious matter. Then later on came the cable system of traction, which raised the speed, and finally the electric, which enabled a service to be worked altogether impossible under animal traction, and so gave the tram an enormous start. Until the advent of the motor cars, therefore, the tram may be said to have justified its existence, as its speed was far ahead of any other vehicle on the road: but now, when we can attain equal speeds, and make use of 'buses with a capacity of some 50 per cent.

in excess of the horse 'bus, its position is greatly changed and its virtues have all but fled, without, however, taking its vices with them.

Still, virtues or no virtues, we have trams, and we shall have to put up with them at least for a time, for otherwise how would the traffic be carried on? The motor 'bus is still far from being an ideal instrument of traffic, though considerable improvement may reasonably be expected in the course of time. Meanwhile how are trams to be operated so as to constitute themselves the least nuisance to the community?

If we admit that tram traffic, as has been shown, differs from the rest of the road traffic, it must also be granted that it should run on a different portion of the road, in order to prevent interference with and by other traffic, more especially as the tram cannot avoid traffic on its course. This then postulates the granting of a special portion of the road width for the sole use of the trams. Here we come to the first reducer of the trams' superefficiency. In a 40-ft. road with trams laid down, 15 ft., or 37½ per cent. of the width, has to be reserved for a special class of traffic, for which the ordinary traffic has to suffer.

Where, of course, tram traffic is in the majority—practically nowhere in the world except possibly America—of course this reservation is not inefficient; but where, as ordinarily, the tram service is intermittent, the superefficiency of the tram is at once reduced by 37½ per cent., and the passenger capacity of the tram is reduced from the equivalent of three 'buses to that of less than two. When in addition you come down to single-floored trams with only half that capacity, and the largest type of motor omnibus, even the excess capacity disappears, while the speed advantage is also lost, resting if anything with the free moving vehicle. In spite of this, seeing that the tram cannot avoid other traffic, it is essential that it be granted a clear right of way over its own lines, irrespective of the state of the other traffic, as without that it loses every particle of its value.

To assist to secure this necessary clear road and right of way, it should be held a cardinal principle, where trams are running on a normal road, that the space they occupy should be paved with some substance greatly inferior to the rest of the roadway. The effect of this would be to keep all other traffic from occupying this special portion, except when forced to do so by circumstances.

In fact, except for the requirements of vehicles wanting to cross the tram lines, kerbs could be run alongside the lines without much decreasing the capacity of the road. Assuming a 60-ft. road, an 8-ft. vehicle leaves 52 ft. for manœuvring breadth. With the trams occupying 15 ft. of the centre, there is left a space of only 22½ ft. on either side of the rails. In the tramless road the manœuvring area was 52 ft.; in the tram road only 14½, because it is theoretically inadmissible for the free vehicle to encroach on the tram portion.

Then again, seeing that the tram is an obstruction, as soon as the rails are laid, and continued so until there are more vehicles running on the rails than off them, it is obvious that the trams and their portion of the road should be utilised to their full capacity, so as to minimise their obstructiveness. This can never be as long as other public vehicles are running alongside of it. If the 'buses take the traffic, the tram is less efficient because the cars are only partly filled; and if less trams are run, however full of passengers, the efficiency is reduced because the lines are not as fully occupied as they might be.

The contention is, therefore, that 'buses and trams mutually exclude each other, and if this were acknowledged, many of the difficulties of traffic in some districts would disappear.

For all-round work and flexibility, the 'bus is far superior to the tram, and it is now only a question of working costs, whether trams ultimately disappear from our streets, as with the motor vehicle we are more or less independent of constructive limitations. Perhaps we have paid too dearly for our whistle of cheap operation, as obtained with tramway operation, and in proportion as the road surface improves, so the traction value of the rail decreases. The cost of 'bus operation is in the main entirely dependent upon the road surface. If this is good, the tractive cost of the 'bus need not be greatly heavier than that of the tram, nor need there be any difference in comfort.

If it were not for the grave defect we have cited against the tram, it would of course be found in the city of London, one of the most congested districts of the world, yet nowhere in these busiest streets are tram lines to be seen. Possibly the authorities could not give their logical reason for excluding them, or why, for instance, it was necessary to widen Blackfriars Bridge when it was decided to run trams across; but they know by experience that the tram principle is unsuited to heavy general traffic, and so very wisely forbid it. Otherwise, if the tram with all its nominal capacity and speed were not an absolute obstruction to the rest of the traffic, it would be just in these busiest streets that their virtues would be most apparent and beneficial. The man of practice knows that they would be impossible.

But because trams are condemned theoretically, it cannot be assumed that they will cease to be used, or even that new construction will not be necessary; there is such a thing as throwing good money after bad just to save at first, and so fresh construction will be required from time to time to link up routes and to improve the present conditions. Also there are parts of towns where rails are laid in narrow streets to the obvious discomfort of themselves and the rest of the traffic; if an opportunity for widening offer, to what extent—for widening costs money—is it necessary?

To maintain any efficiency with tram lines, it is necessary that there should be at least enough width of road on each side to allow one stream of ordinary traffic there; to allow more than two streams on each side is unnecessary and wasteful, unless through some strange chance the land can be acquired very cheap, but unless other traffic has sufficient space alongside the rails it cannot draw up by houses without obstructing the trams. The minimum road width for a tramway system is, therefore, quickly defined and settled.

There are, however, further points in connection with the installation of a tramway, such as the proper position in the road for the track, with regard to which there is much diversity of practice. Some lay double lines down the centre of the road, some a line on opposite sides of the road close to the kerb. Elsewhere they may be seen somewhat off the true centre of the road, or even entirely on one side, and so also with single lines. For urban traffic, it is of course necessary to lay double lines throughout, wherever it is physically possible: a single line must mean a very reduced service of cars, which, as has already been shown, merely increases the inefficiency. Subject to certain very rare exceptions, such as riverside lines, etc., where there are no intersections, and so the laying of the lines on the one side tends to reduce the obstruction, there is but one position in the road for a tram line, to wit the centre. The ebb and flow of traffic is on the average equal, and if the road has to be divided at all, it should be divided equally.

"But," some will argue, "if you place your lines at the side of the road, that is better than the centre because the road then is not divided at all, but merely narrowed." Unfortunately, this system precludes any vehicle from drawing up alongside at least one kerb, perhaps both, for discharging passengers and goods, and further acts obstructively at all junctions and intersections, where its rigidity, of course, would cause innumerable accidents unless speed were reduced far below the tram's potentiality. Laying lines at the sides of the road—one on opposite sides is the only one possibly justifiable—means the railing off of the tram line both from road and pavement, and the stopping of the cars (for safety's sake) at every intersection to allow for the other traffic, clearly an inefficient proceeding.

Further, there is an important point in the matter of tramway service, and that is the position of the agreed halts. It is hardly too much to say that these are always placed at corners, *i.e.*, intersections, where they act precisely as do the refuges and standards in the middle of the road, such as have been already condemned. Just in the position where most room is required in the road stops a bulky vehicle, causing endless obstruction, whereas if it stopped 25 yds. short of the intersection, its presence might hardly be felt.

If the following rule with regard to tramway halts is observed, it will be found that their obstructiveness is largely reduced:—No tramway halt to be at a point making an angle of more than 45° with either corner, and not more than one tramcar to be allowed in a "section" at a time.

Concomitantly with the position of the halts is the duration of them. The halt of every public service vehicle should be as short as possible, and only for the purpose of loading and discharging. No adjustment of the time table is permissible in the public streets, which as has been pointed out are for the purpose of traffic; and traffic means motion. If time tables have to be adhered to, it must be done by regulating the speed of the vehicle. It is the 'bus that is the chief offender here, because in proper circumstances the tram does not affect other traffic, except at intersections.

Finally, arising from the tram's own disobedience of the rule of the road, there must be considered its effect upon other traffic. The difficulty is particularly acute in the matter of the overtaking of trams by other vehicles. The rule calls for the passing vehicles to be on the right (in countries where the rule of the road is to keep to the left), but such an action will cause the fouling of the "up" line, where these are laid double, and the result is considerable danger to all concerned, seeing that the "up" tram cannot avoid the oncoming vehicle. Unquestionably then, in this instance, two wrongs have to make a right; this shows, if anything does, how fundamentally wrong the tram principle is—the overtaking vehicle must pass the tram to the left of it, however long it may have to wait before such an opening occurs. It is the only safe course possible.

And so, to those towns which are blessed with the absence of a tramway system in their streets, we can only say, "Keep them absent." And if any municipality has money to invest, or desires to improve its communications, let it put it into the improvement of the existing road surfaces and an efficient motor 'bus service, for the tramway is merely the confession of an inferior road surface.

CHAPTER VII

GOODS TRAFFIC

Special Problem attaching to Goods Traffic—Possible Restrictions on its Existence—Abuse of Roads by Standing Vehicles—Loading and Discharging Facilities of Goods Vehicles—Underground Facilities—Drawbacks of Motor Transport—Trailers.

THE problem of road goods traffic is perhaps the most difficult of all; it presents an entirely new aspect, in that when goods arrive at the destination of the transporting agency, they have again to be handled, and this tends to cause a vehicle to remain stationary in the road, and therefore obstructive, for much longer than in the case of a passenger, and so creates a new difficulty, inherent to that sort of traffic, which is quite additional to all the difficulties that have been explained in connection with ordinary road traffic.

How to overcome this waiting about in busy and narrow streets, both in loading and discharging, is a problem offering no solution except by the interference in the rights of the individual. And even these reprehensible means will not solve the difficulty.

There are two alternatives of that nature: either the total abolition of goods traffic from the condemned streets, which is unthinkable, or the limitation of the standing time for goods vehicles, which is futile. Were such remedies attempted, they would have to be subject to a special licence, as in certain cases prolonged stay would be imperative for loading or discharge, and so the existing evil would scarcely be affected, whilst the cost of maintaining such a system and the nuisance caused to the public would be intolerable.

Some persons have advocated the transport of goods by night. From one point of view this is very sound, *i.e.*, in theory, as passenger traffic ceases then for the most part, but from the practical point it is doubtful whether householders would altogether appreciate waiting up till, say, 3 A.M. to receive or dispatch a case, while the economy of employing night labour to the required extent would probably be inferior to the existing conditions of congestion.

Of course the railway receiving offices, the large emporia and public houses, which are the greatest offenders, might be somewhat controlled so that no goods vehicles should stand outside their premises at all in certain very busy streets during the prohibited hours. This would, of course, mean the provision of a yard in which to load and discharge, without which it would be possible to receive and dispatch goods during the permitted hours only. Such a measure would probably benefit the busy streets, but at what annoyance to the community?

It cannot but be admitted that these suggestions are only palliatives; nor can they be seriously recommended, since they offend against the primary canon of traffic in regard to freedom of movement. The enforcing of such by-laws would entail an enormous increase in the police force of a town, and a supervision which it is hardly likely that humanity would endure. They would be readier to accept the disease than a remedy of such questionable value.

Another solution is the addition of some 15 ft. to the width of all streets where much goods traffic is dealt with, so allowing space for one column of vehicles on each side of the road. But even if possible—for the cost of such a measure would be prohibitive—the old traffic difficulties would still arise in different forms owing to the road having become so much more attractive to through traffic, unless a special kerb were placed along the road. But then probably, under the pressure of traffic, the public would demand its removal, and so the vicious cycle would again become complete.

So that before any special attempt is made to deal with the goods problem, it will be wiser to note the effect of the abolition of that even more serious form of obstruction, the intersection. Traffic problems are not to be solved by the mere presence or absence of this or that form of traffic. All traffic has to use the streets, and the restriction of any particular class is unfair and an obvious confession of incompetence on the part of the road. That roads are abused is not denied, but a second wrong does not make a right, and the effort must be towards the truer use of the road by that traffic which at present abuses it by converting streets into goods yards. This is the real difficulty in commercial districts, where especially improvement is called for.

It must be constantly borne in mind that roads are for the purpose of movement, not rest. Any vehicle which comes to rest on a road, just as a train in a station, is abusing the function of the road and converting it into a yard. It follows therefore that the less time a vehicle is at rest, the less nuisance it is to the community. It would seem therefore that our main hope of improvement in dealing with goods traffic must lie in the direction of reducing the standing time of goods vehicles; and this is largely a matter dependent upon the human being. Whether it is possible to educate him in this respect is doubtful, though in time, perhaps, as all work becomes more specialised and intelligently performed, it may be hoped for.

Still at present we might institute an improvement by paying attention to the vehicles licensed for commercial use. Just as the police in London impose restrictions on the weight of omnibuses and on the turning radius of motor cabs, so restrictions might be imposed on the goods vehicles licensed. It is notable that a 5-ton lorry is merely a large edition of a 1-ton, and that neither of these has any mechanical appliance for loading or discharging its burden, which may be in units altogether beyond the convenient handling of a human being. Here then is one opportunity for reducing standing time.

A second improvement might be effected in the design of the vehicle itself. To raise a load 3 ft. takes three times as long with the same power as to raise it only 1 ft., yet practically every lorry floor in England is some 3 ft. above the road, though 1 ft. would be ample clearance for town use. The objected difficulties in design may safely be left to the abilities of our engineers.

As a further solution, there has been suggested, and in Chicago actually put into operation, a system of subterranean transit in the shape of tunnels or tubes for goods only. In a purely warehouse centre, where goods are dealt with in bulk, this system has much to recommend it, but for delivery to a consignee, whose business did not warrant his having a siding and station, the road surface would again have to be used. It offers, however, a solution of a small portion of the problem, and if philanthropists can be found to finance it, it cannot but result in easing the roads.

A promising aid is also offered by the pneumatic dispatch system. This will deal with the lighter and smaller articles, and so might reduce the number of delivery carts in use. But, unfortunately, it is not the light and small articles that take the time to load and deliver, and the advantage therefore is so much the less.

There is a further possibility of the dispatch of parcel traffic by 'bus and tram, or by underground passenger trains, and if this can be done without interfering with the passenger traffic, it is all so much gained; but it is doubtful whether this can be done in many instances, and the practice has not developed to any extent at present.

In the matter of the transport of heavy goods, some benefit has accrued to traffic from the use of motor lorries, whose efficiency is considerably higher than that of the horse-worked vehicle. But here again abuses have arisen, which largely discount the advantage in that the volume conveyed mechanically is so great that when it reaches destination, the handling appliances and staff, unless proportionately increased, are unable to deal with it promptly. Worse than this, however, is the habit in motor goods traffic of attaching a trailer to a motor cart. This is both a danger in the streets and an obstruction to traffic apart from the additional volume of goods it concentrates. Although its harm may not, at first sight, be apparent, especially as the method is growing in favour among transporters on account of its cheapness, it has a very vicious effect, both longitudinally and transversely. Considering first its commonest method of use (which is not for goods transport at all), the tram would be thought to be perfectly harmless since it does not interfere with other traffic. If this segregation of the free from the fixed traffic were attainable in practice, the longitudinal drawback of a trailing tramcar would not exist. In practice, it can at once be seen how obstructive the system is, and this is, of course, only accentuated when dealing with free traffic, which should take every advantage of its natural flexibility. A trailer, by lengthening the road occupation of a unit from say 30 to 60 ft., physically prevents that accommodation for other traffic, and may prevent vehicles from overtaking itself and others. Carrying the argument *ad absurdum*, if one trailer is permissible, why not two, three, or six trailers—in other words, a train? I do not think the principle of anyone could be found to justify that, and support for trailers would be for only a very moderate application.

When we come to an intersection, the harm can easier be seen; the car and the trailer block the whole of the cross road, and if two such units are present one behind the other, besides having a very congestive effect on the longitudinal road, they obstruct a length of some 120 ft. of the transverse road, whatever the width of the longitudinal road and the volume of other transverse traffic. Assuming three vehicle widths in the longitudinal road, three omnibuses travelling abreast will obstruct only 30 ft. of the transverse road against two trams with trailers occupancy of 120 ft. This principle, harmful as it can be seen to be in the case of trams, is considerably more so in the case of free moving traffic, because of the lower speed necessary for safety, owing to steering and braking difficulties. A maximum speed of 6 m.p.h. is not sufficient in a congested street where the average rate is probably about 10 m.p.h.

Altogether, the specialisation of the goods problem is the most difficult of all, and from the inherent properties of the traffic seems to offer less chance of successful treatment. Things being what they are, practically the only remedy is by careful and considerate control with that idea in mind. Railway receiving offices need not be allowed in main arteries; large emporia could be compelled to provide their own yards, and not use the streets as such. It is the stationary goods traffic that constitutes the exceptional obstruction, and no interference is permissible with the moving by restriction of hours or route. In this respect the removal of spoil or the bringing of constructional material is not to be considered as pure goods traffic, and its hours can be regulated in the permit for building without causing any special hardship to the contractor.

Such forms of traffic lend themselves to legislative control without hampering the work. But such instances are unfortunately rare, comparatively ; and it must be confessed, that one would in any case hesitate to urge popular representation to frame laws for the guidance of such an intricate matter.

CHAPTER VIII

THE DESIGN OF VEHICLES

Need for Scientific Design in Bulk Vehicles—Tram Exits—Position of Drivers—Double-ended 'Buses—Design of Goods Vehicles—Superstructure.

So far, little mention has been made of the design of the vehicles for carrying the traffic; it is, however, just as necessary that this should be suitable as that the material should be.

In the matter of public passenger vehicles, design is of great importance in the ultimate efficiency; in private vehicles such as cabs and carriages, which are, as has been pointed out earlier, comparatively inefficient, it is not of so much moment, but in the matter of bulk transport its value becomes very apparent.

Up to the present there has been no attempt at scientific design of a 'bus or tramcar from a traffic standpoint. True, the 'bus is differently designed from the carriage which it superseded, but the tram has merely become an enlarged double-ended 'bus, although it runs under entirely different conditions.

To consider the tram:—In principle the exit at the side of the car instead of between the rails is wrong. It causes the tram to occupy more than its width of the road just at the time when it is most obstructive—at a standstill. It is, of course, a relic of the old omnibus, in which the position is right enough, since the omnibus obeys the rule of the road. In the tram, conditions are entirely different, and an entirely different system of loading and discharging should be sought.

On the principle of avoiding obstruction in all matters of traffic, there should be no collision between an incoming and an outgoing passenger; the one should enter in front of the car and the other leave at the back, from central openings between the rails; and the system of hailing a tram would then develop into merely standing between the lines. This proposal may seem somewhat rash to the timid, but no danger need be feared from it in practice, except with a runaway, which would usually give sufficient warning; where several tram routes used the same line, the usual discretion of the intending passenger would have to be exercised, so as not to stop the wrong car. The peculiar virtue of the system would be seen in the discharge, as passengers on alighting, whatever the state of the tram traffic, would be quite safe to look round and choose their passage through the other traffic, instead of being precipitated into the midst of it as at present.

Then again the drivers of all public vehicles should be placed out of all interference from the travellers, and preferably raised as high as possible to enable them to command a good view. The latter is not of so great an importance in the tram as it cannot steer, but for the 'bus it is as necessary now as in the old horse days. Physical non-interference by incoming passengers is essential to all public vehicles, and would further economise space.

It will be argued that the scientific handling of traffic is likely to cause enormous prime cost, perhaps great inconvenience, and little saving of time; but if we are desirous of improving the conditions of traffic, it is only by attention to details and by following the correct principles that the result can be attained, regardless of how long we may have been content to "muddle through" on our old methods. It is not the individual half minute saved here or there that makes the difference; it is the sum of innumerable seconds saved by innumerable vehicles that produces the benefit.

Where traffic is not dense, any sort of vehicle will do for its conveyance—no problem, in fact, arises. But when it comes to putting quarts into pint pots, every additional drop of water evaporated enables more of the essence to be saved, and justifies the trouble and expense incurred.

The principles laid down for the design of tramcars are also applicable to the omnibus, which at present is very far short of its possible efficiency. The future vehicle will have a capacity for some fifty passengers, while its constructional weight will be kept within bounds. With so many passengers to deal with, it will probably have to be double-ended, though the entrance and exit would be at the side; again, to minimise axle weights, it will probably require six wheels. It may then be found preferable to have the inside seating on the old "knife-board" plan, which would allow of central steel pillars to support the roof, and so lighten the body construction, or again, transverse seating with similar pillars might be adopted inside as well as out; while with the "knife-board" seating it might be possible to stow the engine under the seats, and so save greatly in the length of the vehicle.

In fact, the motor 'bus shows just as much want of appreciation of design as the tram, the lorry, or the urban railway car, which latter will be considered separately later. Many old chassis of motor 'buses have been sold for conversion into goods lorries; if suitable for the one, they cannot be so for the other—nor are they. Each class of traffic requires special design for its vehicles.

What, for instance, are the requirements of a goods vehicle? Especially, side exits and a low floor. That is to say, the motive mechanism should be kept entirely in front to enable the whole of the platform to be kept not more than 12 in. above the ground, without any side obstructions, such as driving chains, etc. So also the rear wheels should be as small as possible to allow of the largest side opening.

No doubt these innovations will entail great constructive ingenuity, but such is everywhere to be found among engineers. That ingenuity has not been devoted to these problems hitherto is merely because engineers and designers do not realise what is desirable and attainable. Those responsible for the use of the vehicles do not ask for anything better, and so they do not trouble themselves about educating the users. In confirmation of this may be mentioned the great improvement in turning powers exhibited by modern motor vehicles, due in London to the demands of the police in considering the licensing of motor cabs. As soon as they made their demand, patterns were designed to comply with it, and with this example all motor manufacturers produced similarly improved vehicles. Some day motor car manufacturers will see that it is wrong in design to put the cart before the horse as they now do by driving from the rear wheels. But meanwhile people are content with this system, and so why should manufacturers tax their ingenuity? Similarly for high speed vehicles no weight will be allowed to overhang the rear axle, a fault in design which has been responsible as much as anything for the skidding that occurs in motor cars.

Before leaving this subject of design, attention must also be called to the effect of superstructure on vehicles. The 'bus, tram, covered van and so on rise solidly to a height which obstructs the view of all behind. The old horse 'bus, and, in fact, practically all horsed vehicles, recognised this fact and allowed for it in the design, by placing the driver well above the vehicle, as in the ordinary carriage and particularly the hansom cab. But in mechanical traction no thought has been taken of the demands of traffic. The drivers are all placed as near the ground as possible where their view is enormously restricted. This is no doubt due to the desire, originating from private vehicles, to retain a low centre of gravity, and so allow excessive speed, especially at turns, but this cannot be permitted to outweigh the traffic advantage of a big field of view, and in any case cannot apply to purely utilitarian vehicles, such as we are now discussing.

CHAPTER IX

THE CONDUCTING OF VEHICULAR TRAFFIC

Public Vehicle Operation—Frequency versus Speed—Incompatibility of Tram and 'Bus—Need for Interconnection of Routes and Fares—Monopoly versus Competition—Accessibility—Profit—Waste of Capital.

In considering the conducting of traffic it will be unnecessary to refer to intermittent traffic such as cabs and carriages, as these free lances, given that they have the right to use the road at all, cannot be regulated to any extent.

It is the omnibus and tram traffic that carries the bulk of the road passengers, and, consequently, whose properties we have to consider, so as to render their movement of maximum use to the community.

In tramway or 'bus operation frequency of service is of paramount importance. With the constant stopping that they have to undergo, frequency has to take the place of intrinsic speed, and it is just this fact that causes the enormous congestion on our roads; not only is the speed decreased, which in itself makes the vehicle obstructive, but in addition, further vehicles are required to make good this shortcoming. The tramway, of course, in a properly laid-out line, without intersections and so forth, is not affected, nor does the number of its cars affect the rest of the road users, seeing that it has, or should have if properly operated, its own portion of the road to itself.

And this leads us to one of the cardinal principles in conducting road traffic, viz.: that two types or systems of public "bulk" vehicles must not follow the same route—where the tram is, there the 'bus must not run. Wherever the tram is installed, the omnibus must be content to act merely as a feeder to it, and without any idea of competing with it. The reason of this is sufficiently clear, but we will repeat what we have already shown, namely, that as the tram required its own portion of the road reserved exclusively for itself, it was becoming only less inefficient if that portion was not occupied as much as possible. To allow bulky omnibuses to run, so as to let fewer trams be necessary, or that the trams should run partly empty, is absurd. Once tram lines are laid in a street, the obstruction is there, whether the car is or not.

Then, again, it is essential that public systems should interconnect. Too often, under the municipal system, this important point has been lost sight of. The various routes should also be similarly connected financially by through rates.

Of course, ideally, there should be only one road transport authority—a monopoly—whatever the means taken to convey the people. Competition in road transport is by no means an unmixed blessing, and has involved the community in considerable losses and inconveniences. For an efficient urban service, unity of ownership is practically essential to successful operation; and successful operation means the providing of as cheap, quick, and comfortable a service as possible. Therefore, for indirect journeys, it becomes necessary that travellers should be transferred from car to car under their original ticket, or the journey may become no longer cheap; to comply with the second requirement the cars must run at very short intervals; while for the third, it may be said that most of the cars now running conform to the demands of the public, though in isolated cases there is room for improvement.

Then, further, it is essential that all public passenger services on the roads must run where there is greatest original, *i.e.*, pedestrian, traffic. Accessibility and prominence are very great factors in the success of a transport service. Any form of viaduct or tunnel for road traffic defeats its own ends. Likewise the running of trams, for instance, along the Victoria Embankment in London is a mistake: there is no traffic there. Had they run down the Strand, some excuse might have been found for them, but it is hard to see how they will ever pay their way under present conditions.

And this is the ultimate question in all transport—profit! Without a good return on the capital invested, all public services deteriorate. For many years, transport was considered as a most paying undertaking, in spite of the example of certain unfortunate railways. Omnibus and tram companies made liberal profits, and the service was as good as might in those times be expected.

Then came the municipalising mania, and transport services were instituted everywhere, without regard to the financial prospect, to the economic demand, or to the acquisition of the necessary technical skill for carrying on their operation, which latter was in the hands of the prosperous existing companies, who had the experience of years to guide them. The result in general has been disastrous all round; hardly a single system is giving an adequate return on its capital—many of them in England are running at an actual loss.

Apart from a vicious waste of capital to start with in their construction, the fares themselves have been placed at a figure which leaves no margin at all on the working. The result is, of course, that the public suffers—in municipal concerns through the rates, and in private ventures, which are unprofitable, in the service. For instance, a great deal of the tram traffic both in the south and west of London is unnecessary. The railways were not overladen there, and are not even yet working up to their full capacity, while 'buses were plentiful for the supply of the local road demand. There was, in fact, no justification for the clogging of all the main arteries out of London, and this result is more and more being felt, as the growing use of motor cars increases the use of all roads. Had the money which was spent in the building of the tramways been devoted to the improvement of the road surface, and the existing 'buses been charged an adequate share of the improvement on scientific lines, it is probable that the districts concerned would have developed even more rapidly than was the case, owing to the lesser rates that they would have entailed.

And the result of this is that they are now talking of building new arterial roads out of London at, of course, heavy cost. It would probably be cheaper, and serve the same purpose, to remove the tram lines and repave the roads in those localities.

CHAPTER X

RAILWAYS

Extent of the Urban Radius—Utility of Railway Increases in Proportion to Distance—Differentiation of the Functions of Road and Rail Traffic — Indefiniteness of a "District" — Decay of the Suburban Railway—Causes therefor—Urban Railway Principles —Frequency of Service—Uniformity—Effect on Changes of Trains —Speed the Great Essential—Financial Failure of London's Urban Railways, Attributable to Low Speed—Causes of Low Speed—Reduction in Number of Stops Essential—Access to Stations—Interchange Platforms—Effect of Stations on the Traffic—Design of Cars—Double Platform Stations—Reducive Effect of Junctions —Remedy in Non-fouling Lines — Stations required at each Junction with a Terminal Bay — Cross-overs — Overcrowding—Duplicate Platform Accommodation—Effect on Traffic of Increasing Station Intervals—Summary—Lay-out of Routes—Economy of Stations and Permanent Way Necessary—Traffic must be Drawn from all Sides—Position of Stations—Design of Surface Exits—Need for Co-operation between Road and Railway Services.

We have now considered the various means of travelling on the roads, but in addition to this we have large systems of urban railways, which are responsible for an enormous traffic, and may be likened to an improved tramway system, running (as we have shown to be scientifically correct) on its own reserved road.

Road methods are suitable only for the shorter distances on account of the necessary limitations of speed imposed on them. Modern towns, however, impose no such limitations on themselves in respect of area within which constant communication is demanded. The growth of towns follows a development of country into suburb, while the suburb gradually becomes merged and physically incorporated into the town. It would be difficult to define where, for instance, the eastern and southern suburbs of London began. No doubt they are still termed suburb, but all the old amenities have passed away, and have been replaced by countless houses, containing mortals all more or less dependent on the great city for their daily bread.

The true suburban radius has therefore extended much further — at present it may be said to stretch to some 30 miles from the centre, and the old suburban railways have become very largely urban, and subject to the laws of urban traffic just as much as trams. That they have only just begun to be so operated shows how little the proper aspects of traffic have been considered.

The distance therefore over which railways are required on an urban basis to operate tends to grow every year, and in proportion as the distances increase, so the utility of the tram and 'bus falls. For short distances their high acceleration, frequency and handiness show them to be paramount, but for the longer, the frequent stoppages and the comparatively low average speed disqualify them. Consequently it may be laid down that for traffic within a district the road method is the more suitable, while between districts the railway is essential. It is, of course, impossible to reduce the term "district" to any hard and fast boundaries; districts are generally matters of personal predilection and geographical disposition, and cannot be defined in terms of yards and feet. They are rather matters of time occupied in traversing a distance than the actual distance itself, and as speeds increase, so will the area of districts expand.

A feature of modern transport may be said to be the entire victory of the road vehicle over the old suburban railway, and this is quite rationally explainable from a traffic standpoint, apart from the question of profit or loss on the services. In the days before mechanical traction was utilised for road transport, the suburban dweller had no option but to travel by rail: no matter how long the journey took it was quicker than any road travelling. On the introduction of the electric tram, and later the motor 'bus, it was found to be often more convenient and speedy to travel by road, instead of having to conform to a time table, which might not be suitable, and take a conveyance which was very little quicker in its actual travelling time. Consequently, the railway lost its traffic, and rightly so, by its inability to adapt itself to the new conditions.

We will therefore endeavour to show what are the principles which govern urban railway traffic. The first is frequency of service, very much as with all bulk vehicular traffic—without this the slower speed of the road vehicle is compensated for by the longer wait for the train, in addition to the inconvenience of having to go to the train and the loss of time involved if any considerable change of level has to be made at the station. In addition to frequency, the service must also have uniformity. An urban railway should never require a time table; the frequency and the speed must be assumed by the public or they will hesitate to use the line. The running of trains which avoid certain stations at certain times is impermissible on an urban railway: it introduces an element of uncertainty, which in these days of small margins and keen competition destroys its chances of attracting traffic. It is, of course, permissible to increase the number of trains from the minimum during the hours of maximum traffic, but it is not permissible to quote the "rush-hour" frequency as the standard, and then during quiet times reduce the service.

Given a three-minute service as the standard, it hurts no one if this is increased to a one-and-a-half-minute one during certain periods of the day. But if it is dropped to a five-minute service — be it only for one hour—harm is done. The maxim of the railway manager should be to get his public to adopt the railway habit, and this cannot be done if they are in any way disappointed with the speed of the service.

Frequency of service, again, is especially necessary on account of the many changes that railway travellers may have to make. A universal five-minute service may mean a loss of nearly fifteen minutes in a two-change journey—nearly ten minutes in a one-change, while a three-minute service can mean only less than nine and six minutes' loss respectively. The difference is important, as such waits may form the major portion of the total travelling time. Even, however, with an equality of frequency, the railway is still at a disadvantage with the road service, in that the latter comes to you, so to speak, while you have to go out of your way to the former. This point gives the road service a very high "comfort" factor in comparison with railways.

To overcome this, the railway must hold out some other inducement than mere frequency to attract passengers, and the only one it can offer is speed. With its clear and guarded road, it can run at speeds which the road vehicle would never dare to touch, however capable as they now are of attaining them.

And so we come to another postulate, that for an urban railway to be satisfactorily utilised, the time of travel between two points must be proportionately faster by rail than by road, and as the latter increases, as it undoubtedly will, so must the former. Unless the time saved by the train is so great as to overbalance the greater amenities of the road, traffic will not be attracted to it.

These contentions seem so obvious that it is hardly possible to imagine that they are not universally practised. In London they may be said to be entirely ignored, for the average speed from surface point to surface point on the tube railways there is very little over 12 m.p.h. In practice, the railway speed should be such that no road conveyance can compete with; then it will specialise in carrying the fast and long-distance traffic, while the road will cater for the local demand. Thus the latter becomes a feeder of the railway, and both exist for their mutual advantage, instead of, as now, in direct competition.

The present speeds on the London underground lines are obviously insufficient, and have proved themselves so by their financial failure, and it is safe to assume that if the speed of travel were increased to an average of 20 m.p.h., far more traffic would be attracted to them. The point, however, is that, as at present operated, it is impossible to realise such speeds, and so the railways suffer.

To consider how such a speed is attainable, it is necessary also to realise the natural laws which govern bodies in motion. Retardation and acceleration have their limits, and all the time they are being exerted, the maximum speed of the train is not being realised. To put the matter simply, it takes time for a train to reach full speed, and time also to stop it, though in the latter operation not so much. Therefore, the fewer the stoppages, the less the waste of time and the higher the speed. Yet in these same London railways the average distance between stations is half a mile, so that in a run of six miles there are, say, eleven intermediate stoppages. Now even eliminating the actual time at rest in the stations, say twenty seconds per station, eleven times making 220 seconds, or nearly four minutes, the actual time that the train is running at full speed on such a journey is very small; the travelling is made up of a series of accelerations, followed almost immediately by decelerations. If this primary fact be recognised, that it is impossible to have high railway speed with frequent stoppages, however powerful the motors and the brakes, and however perfect and even extravagant the system, and that speed alone is the *raison d'être* of a railway, much can be done to reinstate them as a public benefit in towns. The New York engineers have fully recognised this essential fact in their railway systems, by providing extra lines to enable trains to proceed express from point to point, and this is the best example as yet devised. That even this is far from perfect can be seen by the continual complaints made against it, while it too fails to pay an adequate return on its capital. It is, in fact, questionable whether the expenditure of the additional capital for the duplicate lines underground is economic, in view of present surface facilities, and whether any town could afford to maintain it.

Again, part of the journey time on railways is occupied on foot between surface and train, and this forms a bigger proportion of the total journey time as the journeys grow shorter, while under all circumstances it adds to the total journey time, which should always be reckoned in maxima rather than in minima. It is therefore of prime necessity that access to stations should be as free and rapid as possible, and continuous access should be provided, while the distance between street and platform should be of the shortest.

Equally at junctions and interchange stations, distances between platforms must be reduced to the minimum, or the time lost in making the transfer will so increase the journey time that perhaps other means of transit will be adopted. And as it is impossible to run through trains from any given point to any other given point with any frequency, the junction and interchange station must play a very large part in the conducting of the traffic.

In addition to the loss of time entailed in a distant interchange, there is the proportionate length of walk to be undertaken by the passenger, which affects the comfort factor, just as the loss of time affects the speed factor.

The station is additionally a bar to rapid and frequent working, altogether apart from the above causes. It is obvious that in a direct service between two points there is practically no headway required theoretically if the cars are moving at the same speed, the headway being required solely on account of the stoppages of the trains at the various stations or *en route*, and for possible variations in speed of running *en route*. This affects the four-track line no less than the two-track, and it is therefore to the stations that attention must first be directed.

There are two means for mitigating the nuisance caused by stoppages, and the foremost consists in the scientific design of the car and of the station. One of the chief reasons for the length of the station stoppages is that no provision is made for cross currents of passengers, and this is the first fault to be eliminated.

In many of the present designs of cars, seats are arranged longitudinally, or partly longitudinally and partly transversely, while doors are placed at the ends of the cars, and sometimes also in the middle. Longitudinal seating has the defect of providing a minimum of seats and a maximum of standing room, because the cars are not wide enough to allow of more than two longitudinal seats in the space available. In practice the excess of standing room reduces the comfort of the passenger, and so should be discouraged from that cause alone, while it has a severe traffic drawback in the difficulty experienced by passengers when alighting, from the gangway space being occupied by standing passengers, which increases the duration of the stop, and lowers the speed and frequency of the service. On the other hand, a passenger occupies less room standing than sitting, and so during rush hours more passengers can be crammed into a train than when the majority are seated.

The normal capacity of the 50-ft. coach in use on the London lines is forty-eight seats, with doors at each end and in the middle, but if the seats were transverse throughout, it would be possible to seat sixty-four persons, allowing a gangway down the centre of the coach, with seating for four persons in each "section." The vestibules would be abolished, and instead there would be a sliding door to each section, so that not more than eight persons would make use of any door at any one time. Under present conditions a car may hold as many as one hundred passengers who have to make use of three doors, while unless all the passengers are leaving, there is bound to be internal obstruction before reaching the doors, which have to accommodate thirty-three persons against the other design's eight. Even with strap-hanging, which no doubt cannot be avoided, the transverse design causes hardly any internal obstruction, and it is difficult to see why it was ever departed from, as it forms the standard for all main line traffic (Fig. 10).

It may, of course, be objected that side doors controlled by passengers are too dangerous with the high acceleration speeds of electric railways, but it is hard to see any justification for this, as at present passengers stand in the vestibules of the "District" and "Metropolitan" trains, without untoward results, and it seems unlikely that they would run greater risks when seated.

If the side door principle is adopted, we are led by a natural progress to the double platform principle, where separate platforms are provided, one on each side of the line for loading and discharging respectively, so that there is absolutely no interference between the incoming and the outgoing passenger, and this is the ideal method, as the flow of passengers is then entirely in the same direction. On this method it is almost impossible for as much as ten seconds to be occupied in clearing a train, whatever the density of the traffic, and this is, of course, of greatest value in coping with the "rush" traffic.

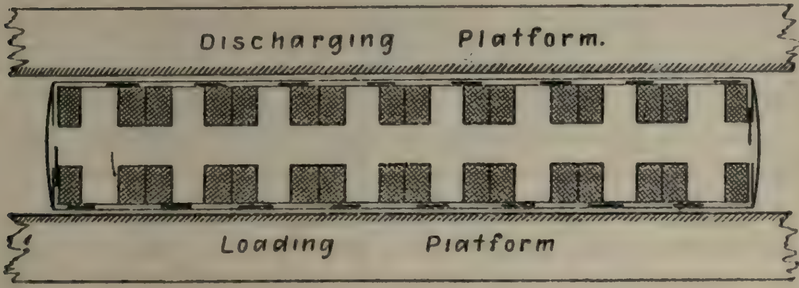


FIG. 10.—Plan of 52-ft. Car for Urban Service, seating sixty-four passengers transversely, with central gangway and through communication between coaches, and side doors to each "section." Efficiency = eight seats per 6 ft. 6 in. run of coach.

Under the existing methods, the length of stops is proportionate to the density of the traffic, whereas for satisfactory working it should be inverse; for the denser the traffic, the more imperative it becomes that trains should be got quickly away from stations, to allow of a maximum service. On the double platform principle the length of stops is practically constant, whatever the density of the traffic.

Even, however, when station stops are reduced to a minimum, the capacity of a line may still be kept low by another bar—namely, junctions. On a double line route this means that every down train going east fouls the up train from the west, in addition to the normal waiting required by trains which are running on to the same line. Strangely enough the importance of this has been fully realised by the great trunk railways, and flying junctions are frequently to be seen in England and elsewhere, in order to prevent the non-fouling of one line by another. But the urban railways do not seem to consider such a facility as indispensable as it actually is for them, with the enormous traffic that seeks passage over their lines. As the lines are now designed it becomes a physical impossibility, no matter how perfect the stations and the train equipment, to pass more than a given reduced number of trains through a junction.

Important, too, if not essential, is the provision of a station at each junction, preferably before the lines diverge, in order that passengers having to change trains should have a minimum of distance to go, while an additional terminal bay, connected with the through lines (either both or only one pair) before their junction, must also be provided, to enable trains from one or both branches to terminate their journey and reverse there, to allow of the same frequency of service on the branch line as on the joint (Fig. 11).

To effect this requires a bay platform either between, below, or above the station platforms. Assuming a line running east and west with a junction of two branches from the north and south respectively, and assuming the southerly branch to be kept on the level throughout, then the down northerly will dip below the up southerly, thus giving an ordinary flying junction. With the bay connected to the up and down lines direct, a certain amount of interference can arise, as a down southerly train cannot leave the terminal if a down northerly train is also leaving the through platform.

If complete non-interference is desired, and ultimately it is almost sure to be found beneficial, the lay-out should be so designed at the start that the additional lines

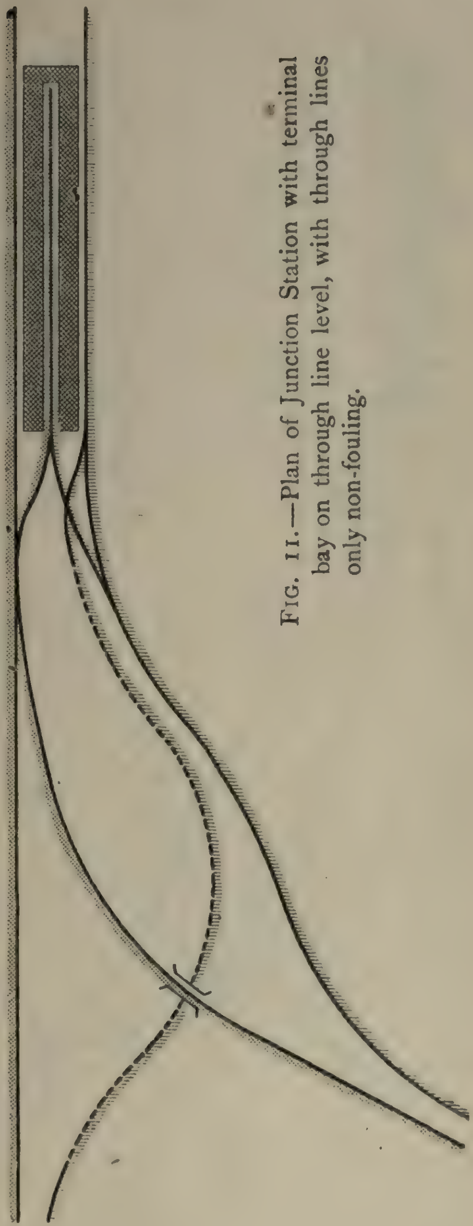


FIG. 11.—Plan of Junction Station with terminal bay on through line level, with through lines only non-fouling.

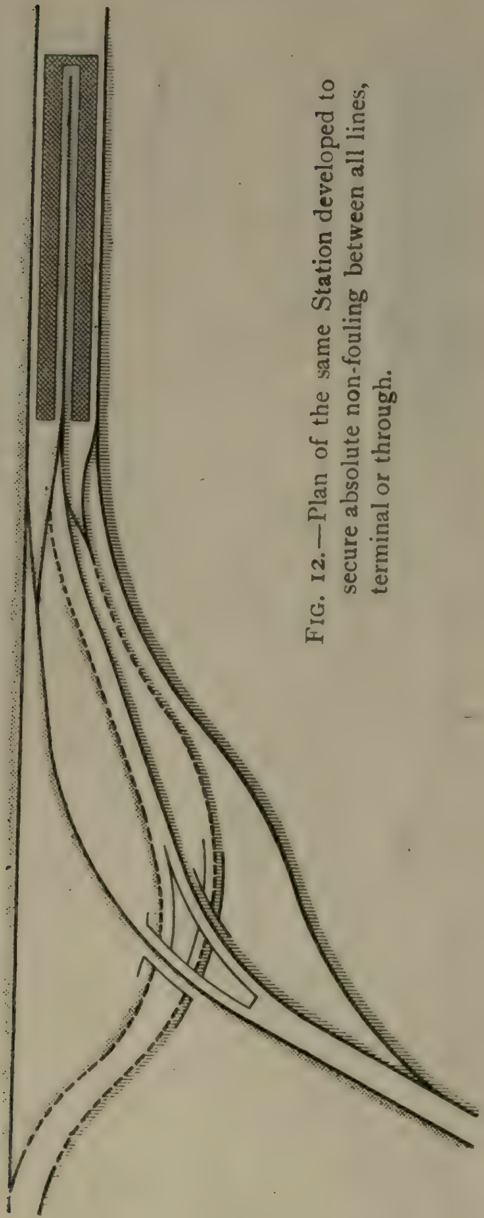


FIG. 12.—Plan of the same Station developed to secure absolute non-fouling between all lines, terminal or through.

required for this can be inserted afterwards without disturbing the existing service. The extra construction involves a spur from the up north branch, dipping below the up south branch, and rising again to the level just outside the bay terminal, while the down southerly terminal line must similarly be taken between the down northerly through, and the new up northerly terminal, passing over the down northerly, before joining the down southerly. In this way an absolutely unrestricted service can be given, either on the through or the terminal lines (Fig. 12).

If the terminal bay is below the through platforms the complete non-fouling junction should be installed at the start, as no great saving is effected in construction, unless it is decided to connect only one branch with the terminal (Fig. 13).

In general, the low level terminal is better adapted to the double platform system, while the upper level is better if only single platforms are adopted. But if the double platform is of value anywhere, it is particularly at junctions that its virtue is felt, owing to the large load of passengers to be handled at such stations. As, however, at the present day at any rate, the single platform system is likely to obtain, it is well to point out the respective advantages,

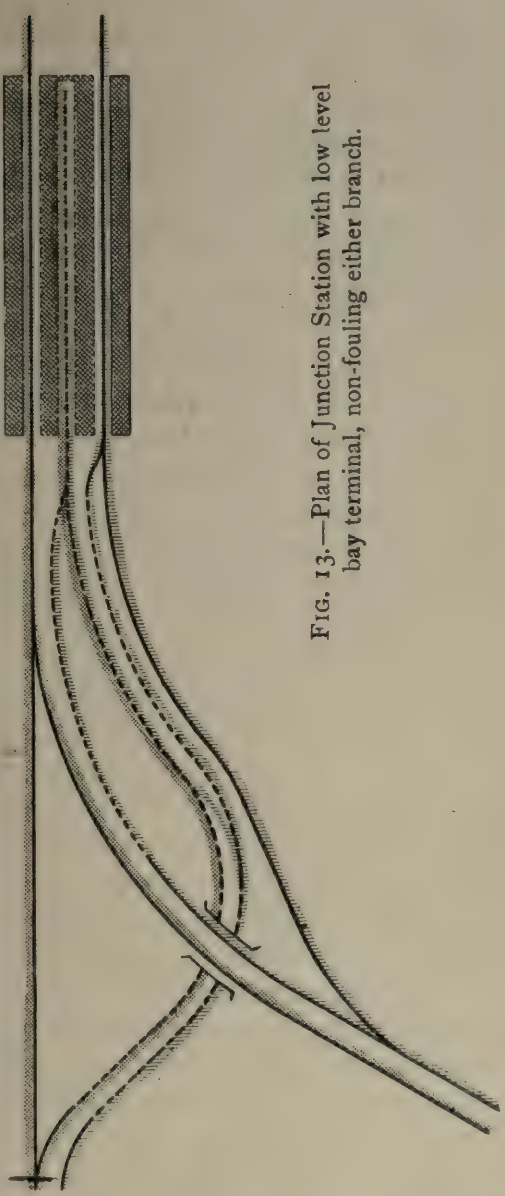


FIG. 13.—Plan of Junction Station with low level bay terminal, non-fouling either branch.

so that a low level bay is not installed on a single platform system.

In addition, cross-overs should be provided at reasonably frequent intervals, preferably at each station, and a reception siding between the lines to allow for emergency services and shunting in case of breakdowns. It will, perhaps, be held that emergencies cannot be provided for economically, but in the case of such a simple and comparatively cheap expedient, its provision is not unreasonable.

With non-fouling junctions and terminals the obstruction ordinarily caused disappears, and the onus of delay is then thrown back on to the stations or to the limits of physical acceleration and retardation. It is the continual cry, not only in Europe but in America too, that trains are overcrowded at certain times of the day, and the complaint is also just. The state of affairs is, however, equally unavoidable in most cases, because the carrying capacity of the line has been reached. Any system which diminishes the number and the length of the stoppages will increase the capacity of the line and so reduce overcrowding; and as overcrowding is a matter which affects the comfort factor of a railway, the prudent manager will seek to reduce it by all possible means. Shorter and less frequent stoppages mean less headway between trains, in addition to the actual acceleration, and so are beneficial in every department of the service.

The second means for reducing the evils of stoppages is a palliative, and consists rather in minimising their effect than in any actual reduction of time occupied standing in the station. It necessitates the provision of two station lines for each running line, so that no slowing down is necessary for the following train on account of the train in front being at rest. This provision has no effect in quickening the running schedule, but it overcomes the difficulty of the obstruction to the running. Economically, however, it is inferior to the plan of devising stations and trains so as to cause no obstruction to passengers, and in practice would probably be a more expensive expedient. With stations suitably spaced, and stops of from five to ten seconds, there should be no difficulty in running trains with only one minute's headway. And this is all that the most exacting manager is now looking for.

These counsels of perfection may be all very well for towns that have not committed the mistake of designing their lines wrongly, but they are not of the same value for the existing lines. In London particularly, where the trouble is greatest—and financial trouble can usually be traced to physical causes—the four-track recommendation is useless; no one can afford it. We are therefore faced with the problem of how best to utilise two-track lines, in order that they may still become profitable to their owners and in consequence fill a want.

Let it be granted that a material increase in the speed is necessary. How is this to be accomplished?

It has already been shown that traffic within a district will always travel by the surface; therefore, as a result, the railway is for the conveyance of passengers from one district to another. What then is the limit of a district? It has already been defined as the extent over which it is preferable to travel by the surface than by rail. For a distance of ½ mile, obviously, the tram or 'bus is the quicker vehicle. For a mile run, the tram will take some eight minutes while the train will take about 2½ minutes, but to get to and from the train at least two minutes must be allowed at each end—in tubes there is the lift journey in addition which adds another minute, which brings the journey time up to about the same as by road, and in practice it would probably exceed it, so that 1 mile is the very least distance over which the train can begin to attract traffic from the road; in practice the tram competes over much longer distances.

However, let us recognise that on the average, at present, stations should not be less than 1 mile apart, and let us then consider the effect of such a plan on the traffic. It will at once be admitted that such a plan enables the running speed to be very materially increased, and offers no corresponding disadvantage in respect of frequency—quite the reverse in fact. But it has the defect of requiring the traveller to walk farther to his station. Assuming the railway to serve a stretch of ½ mile wide on each side of the line, the average additional time consumed by the traveller to reach his station is ⅙ mile, say three minutes at each end, or six minutes in all, walking. If in a hurry, the traveller will take a 'bus or tram and so save some of this, while in practice the time lost would not average so much, because the bulk of passengers collect at certain well-defined centres of traffic, and the intermediate stations between these are used by the few, not by the many. In practice, then, the loss of time in getting to the station would be more than balanced by the saving of time actually travelling, while the reduction in the number of the stations would enable working expenses to be considerably reduced.

It would, however, be impossible to put such a scheme as this into operation without making other provision, as, if successful in attracting additional traffic, the load on the car entrances, lifts and platforms would be strained to the breaking point.

We will then consider what the proper specialised equipment of an urban railway should be, so as to pass a maximum of traffic when required. From this we shall be able to see what reconstruction is necessary for the existing lines to perform their intended functions.

1. Where feasible, the stations—and for running purposes the lines—should be as near to the surface as possible, and approached by stairs or inclines. This does away with the difficulties and loss of time and money caused by maintaining lifts. Where, however, great difference in the levels cannot be avoided, and lifts are required, they should be for the most part continuous, so as to allow absolutely free access to the trains. One lift of the ordinary type is sufficient accommodation for nervous and unathletic people.

2. All junctions should be non-fouling. This precept should be practised wherever possible, and in new construction made a cardinal principle.

3. All stations should have two platforms per line, one for loading and one for discharging, and preferably two lines per route line. The latter allows of one train catching up another at the points of greatest congestion, the stations, and so reduces headway; the former is to keep the flow of passengers into and out of the trains from clashing. This necessitates carriages with transverse seating and side doors between each pair of seats with a corridor down the middle.

4. If construction costs can be kept low, four running lines, allowing of an express service, is the ideal system. In the case of existing lines it is, however, impossible, as the cost of quadrupling would be equal to building a new line, and for tube construction generally this would always be. As the tube lines do not pay on their short distance traffic, it is doubtful whether this system would ever be economic for them.

5. All junctions to have a station with a bay terminal

just before the parting of the lines, to allow of an independent service starting at that point.

There remains still the question of the routes of urban railway systems, and in dealing with this it is possible to lay down only very general principles, avoiding details altogether.

First and foremost, all urban railways should be laid out comprehensively; urban railways cannot be considered as isolated fragments, running independently for their own advantage, as was done when the various London tubes were planned. Intimate combination is essential, if success is to be achieved.

Recognising the fact that the railways are for the conveyance of passengers from one district to another, it is necessary that care be taken that each district is served by one station, and no more. The duplication of lines in the London system between Paddington and Regent's Park, Hammersmith and S. Kensington, Moorgate and Old Street—some 4 miles in all—oppose this principle. In fact, they halve the potential traffic of the point, except for the slight new traffic induced through avoidance of change of train.

A railway district, on the plan laid down for a double line railway, comprises not less than 1 sq. mile. It is, of course, impossible to adhere to any strict rule as to distances—towns have an awkward way of so disposing themselves that hard and fast rules become more honoured in the breach than in the observance. A noticeable feature of towns is the water flow that is usually to be found there, either a river with meandering course, or the sea with jagged edge. This forms an absolute barrier to traffic, for passenger ferries are a poor substitute for bridges or terra firma, in addition to interposing a gap of waste land, so to speak, between two populous districts. It therefore becomes impossible to lay out a system on any special geometrical plan. All that can be done and must be provided is that the railway shall serve the mean of a district, and that all exchange points shall be concentrated as much as possible. Examples of non-appreciation of these principles can be seen in London in the District Railway between Westminster and Blackfriars, where it is bounded by the Thames on the south side; on the Central London Railway between Marble Arch and Notting Hill, where it is bounded by Hyde Park on the south; and on the Great Northern and Piccadilly between Sloane Street and Dover Street, where the line is first bounded by Hyde Park on the north, and then by Green Park on the south. This running along the confines of natural districts means drawing traffic from one side of the line only and so reduces the railway's utility by half—a suicidal policy.

Concurrently with this must be considered the position and lay-out of stations. These, in a properly organised system of transport, should be placed on or near some standard artery on which public vehicles ply in order to effect easy distribution and collection of passengers. But in this case adequate circulation must be allowed for at the exit, or the street will become unduly congested with the discharge from the railway.

To prevent this, a forecourt on the pavement and adequate frontage must be allowed for, or, if the station is at a corner, an entrance on to both streets should be provided. Though of no importance from a railway point of view, it is of very considerable moment to surface traffic that a large number of passengers should not be suddenly discharged through one opening on to the pavement, and this point can be ensured by parliamentary interference. Further, where stations are on arteries, a subway should be built across the artery, to avoid congesting the roadway by passengers from the railway wishing to cross the street. This would require the lifts or stairs stopping short of surface level, but as 10 ft. would be all the depth required, this drawback is not of very great importance.

Where stations are not on arteries, they suffer in popularity to a certain extent; especially would this be so with longer intervals between stations, causing more 'bus or tram riding to be undertaken. To institute a 'bus service necessitates a frequency of surface traffic equal to that of the railway, and this might not always be feasible economically; otherwise the placing of a station in a side street has the advantage of distributing the passengers at a point little congested, while land for the buildings is more cheaply acquired.

But if the co-operation of the surface with the underground traffic is striven for, instead of the competition which has been so harmful in the past, both railways and surface vehicles will increase in popularity, whatever the position of the stations. And this is, of course, the prime aspiration of every traffic manager.

CHAPTER XI

WATER TRAFFIC

Inferiority of Speed by Water—Inherent Drawback in Conducting Passenger Traffic by Water—Ferry Services—Loss of Time at Terminals—Design for a Transporter Bridge—System for Loading and Discharging Ferries.

We have still one item—a minor one—of traffic to pass in review, and that is the conducting of traffic on and over water by means other than viaducts, namely, by ferry or small boats and by transporter bridges.

With the exception of ferry services, water-borne passenger traffic in towns is not of great importance; it can never compete with land-borne in point of speed, and so, as a means of passenger transit, can never be very great. Economically, too, there is the fatal fact that river- or canal-borne traffic runs along the confines of natural districts drawing practically no traffic from the bank of the river opposite to the station. And so we will merely thus point out the futility of attempting to use waterways as a means of traffic except where there is no option. The method is out of date, and cannot compete with the tram in point of comfort nor the railway in point of speed. The recent attempt to resuscitate the service in London met with disaster, as it deserved; that Paris still maintains a river service is possibly eloquent only of the lack of other facilities there, and it does not seem dangerous to prophesy that it will disappear in the course of a few years.

We cannot, however, treat ferry services in this abrupt manner; these must always remain in use to a certain extent, where the ordinary bridge or a tunnel is impermissible on the score of shipping or expense; but it must also be frankly admitted that the capacity of a ferry service is very limited, and that its speed is bound to be slow; that if the traffic is to grow to large dimensions, the number of boats required will seriously congest the waterway, and that there is therefore a very well-marked economical limit to their use, apart from the ever increasing demands from the travelling public for better speed and facilities than the ferry boat from its very nature can afford. As for the transporter bridge, which is a non-floating ferry service over a narrow waterway, it is still more limited in its capabilities and applications, though it has a considerable advantage in speed from working over a rigid medium and being independent of tides and currents.

The great object in all ferry services must be to reduce time at terminals, as it is here that the chief waste occurs. In a transporter, the time occupied in loading and discharging can exceed the time of travel, and this forms a very serious bar to its utility, as adding to the journey time, and reducing the capacity of the bridge by the fewer journeys possible. Yet the time taken at terminals can be immediately halved by carrying on both operations simultaneously. Access to the platform of a transporter should be from behind, and exit in front, so that when it arrives in its dock loaded, discharge proceeds immediately, while the loading is similarly completed almost as soon as the last vehicle has left the platform. The fact that horse traffic would be facing at right angles to the line of motion need not be a drawback, as the control of the platform can be made so exact and smooth as to render it almost unfelt.

When we come to the ferry service, we are faced by a very different problem, and one much more insistent, owing to the indispensability of boat ferries in harbours of wide waters. All water-borne vehicles suffer from proximity to land, whether it is the ocean liner that tries to keep rocks at a distance, or the ferry boat that has to come alongside gently.

The same principles apply for the ferry boat as for the transporter, as regards loading and discharge, but it is easy to see the greater difficulty of reducing them to practice. On the other hand, those who have watched the working of a busy ferry boat, such as ply in the Hudson at New York, will admit that the system is wanting. It is a mere enlargement of the primitive country river, or lake ferry, without the slightest attempt made to specialise the instrument for its purpose.

Now, although it is admitted that the adaptation of a water-borne platform to land traffic is a matter of some difficulty, it is by no means impossible. Special design is necessary both for the boat and for the dock into which she is to ply; and as speed at terminals is essential, there must be no intricate passage to negotiate for the boat; the journey must be straight across, and the dock entrance as near as possible square to the average course. Then with a rectangular-shaped platform, with bulwarks opening outwards, forming a gangway whereby to leave and to get on by, the vessel would conform to the transporter system. As for the dock, there should be some system of buffer guides to take the vessel easily into the working portion, which should be long enough to allow ample water room towards the shore, in case of misjudged speed, while additionally some form of hydraulic buffer might be fitted for additional safety. The main shocks—those caused by the vessel in entering the dock—would be longitudinal shocks for the horses, and so less objectionable. Such a terminal requires, of course, more land space than the present plan of a single entrance and exit in combination, but it would be found that on such a system, one dock would do the work of two.

The urgency of some such arrangement is, of course, less in the case of the ferry boat than in that of the transporter, on account of the length of the journey being so much greater in the former case, and the loss of time at terminals therefore less in proportion to the total time of travel. As a means, however, for expediting a ferry service, and enabling traffic to be handled in excess of the limit under the ordinary methods, its virtues demand its adoption wherever room can be found for it.

CHAPTER XII

THE SAFETY OF THE PEDESTRIAN

Increase of Street Accidents due to Motor Traffic—High Speed not Necessarily Dangerous—Excessive Speed is, whether High or Low—Difficulty of Defining "Furious Driving"—Effect of Physical Restraint—Recklessness induced by the "Horn" and by the Speed Limit—Effect of their Abolition—Noise Effective only if Intermittent—Physical Attributes of the Motor—Deflection Facility—Compactness—Speed Variation—Effect of Refuges on Safety—Their Location to avoid Obstruction—Railing off Pavements—Danger must exist in Crossing other Traffic—Effect of Trams—Overbridges and Subways give Absolute Safety—Their Non-use and its Causes—Lifeguards only Palliatives, and no part of the Principle of Careful Driving—Speeding up on Railways—Effect of Panic in causing Congestion.

With the increase of road traffic, particularly since the introduction of motor cars, there has come an increase of accidents to the pedestrian, which may occasion fresh legislation, probably of a repressive tendency, which is likely to do more harm than good, unless based on scientific deductions.

It cannot be maintained that the legislation and regulation, to which street traffic has been subjected, has been particularly successful in its results, or the danger would have declined instead of increased, as has been the case in railway and steamer traffic, factories etc., and it may therefore be that the legislation we have is not extreme enough; or again it may be wrong in principle. That it is due to the latter I will try to establish.

It will generally be admitted that it is impossible to legislate to secure entire immunity for the foolish, and that among pedestrians there is a large proportion who are of that class. To legislate on this basis would render traffic impossible. Similarly it is impossible to make a driver humane and careful by Act of Parliament; reckless driving will continue as long as man is what he is, but will decrease in proportion as he ascends in the scale of nature.

We will therefore consider the position from the point of dealing with the normal mortals who constitute the majority. Regulation in England has always been in favour of the pedestrian, as may be seen in the provision by law of audible notice of approach, speed limits, refuges in crowded streets, and subways, and it is sad to think that with all this effort, to say nothing of the numbers of police who hold up traffic for the protection of the pedestrian, accidents should have so increased. It will be urged, of course, that this is not due to any mismanagement, but to the increase of speed in the traffic, and that, therefore, the pedestrian is bound to be less safe than before. In that far the reforms advocated, all having as their object the speeding up of traffic, are bound to be more harmful to the pedestrian than the present state of congestion.

But the argument is fallacious; higher speed *per se* is no more dangerous than lower speed, provided that it is not excessive. Excessive speed is undoubtedly dangerous, and it is not denied that high speed is often too high; but it is only in the excess that the danger lies. If 5 miles only per hour is a safe speed under certain conditions, then 10 m.p.h. is dangerous; but if 30 m.p.h. is a safe rate, as it undoubtedly may be in many parts of open country, then under these conditions 20 m.p.h. cannot be dangerous, though it is double of what has been agreed as dangerous under conditions.

Nor can it be contended that excessive speed has ever been advocated in any of these pages; if we resort to the maxim laid down as our ideal, it was "speed without offence," and creating danger is a very grave offence. It is because under the present system there is so much offence that there is so much danger. If a vehicle is given a free course, 20 m.p.h. is not an excessive speed, yet no motor car could average that in crowded streets without driving to the public danger many times during the run. It will be seen that if a vehicle is held up in a block for two minutes on a 2-mile run, the speed for the journey, which at 20 m.p.h. takes six minutes, has to average 30 m.p.h. to achieve the same result.

Further, it is not necessary in driving to the public danger that an accident should follow, though the offence has been committed just the same. This is one of the great difficulties of the question of furious driving. Where is the line to be drawn? The accused pleads that he was proceeding reasonably, and in proof thereof he claims that he did no damage. How can his argument be ignored? Yet his behaviour may have caused other accidents or damage not directly traceable to him.

Faced with this difficulty, the authorities seek two means of restraint, the one physical, such as refuges and police standing in the road and partially or completely blocking it; and the other moral, such as speed limits and the obligation on the driver of a motor car to give audible notice of his approach.

Let us deal with the latter principle first. The noise obligation, which we will call the "horn," can, I think, be shown to be largely responsible for the increase of danger in traffic. It has given the motorist the idea that the road is his of right, and that the pedestrian or slower vehicle must give way to him, and that so long as he sounds his horn, he is relieved of the consequences of careless and furious driving. And in practice, especially in the early days, pedestrians certainly from their fear of the danger did so accord them right of way. In consequence the speed and arrogance of the motorist increased very largely, until now he dashes past crossings at full speed with merely a preliminary hoot, instead of slowing his pace to the limit of his braking distance, until he can satisfy himself that the road is clear.

The other regulation, the speed limit, operates to the public danger in much the same way. As long as a driver keeps within the speed limit, he imagines himself driving carefully and immune from all liability. In towns where restricted speed limits are in force, accidents still occur, for 12 m.p.h. is quite sufficient for killing a person. Of course, reduced speed means increased safety in the lowest speeds, but as soon as a possible non-danger speed is exceeded, say 4 or perhaps 3 m.p.h., an accident may occur; and there is unfortunately no question of the effect of such a limit on traffic. Absolute safety, therefore, is unattainable.

Let us now turn to the other side of the picture, no horns and no speed limit, and see how this would work. The driver would at once get into the habit of judging pace, and of avoiding obstructions, instead of expecting them to avoid him. No motorist hoots at a refuge or even at a tram-car; he knows it would be futile: but the pedestrian is fair game, and may be expected to get out of the way. Had the motorist no horn, he would have to avoid the pedestrian, as he would any other obstacle, and so one great cause of danger would be removed.

Similarly, it is an unnecessary restriction to limit speed to 20 m.p.h. If this is for the public safety, is 18 m.p.h. safe? Is the critical speed exactly 20, and 19.5 m.p.h. safe, while 20.5 is dangerous? If public safety is in question, 6 or 7 m.p.h. may be all that is advisable for perhaps 50 yds., while 30 or more m.p.h. might be quite safe for the next quarter of a mile.

Many pedestrians might ask to be saved from such a condition of affairs, preferring the ills of the present, while motorists will, of course, contend that while quite in favour of abolishing the speed limit, the horn must be allowed them if only to prevent pedestrians from suddenly stepping out in front of a car, and the claim seems plausible. Its only weakness is that it is a very common source of accident with the horn in use, and therefore the horn does not preclude, though it may diminish, accidents from this cause, which arise mainly from the absent-mindedness of pedestrians. But the absent-mindedness of a driver might also cause an accident, and therefore no motor driving would be possible at all, unless let us say dual control of the steering and the engines was enjoined by law. Besides, the silence of the modern car can easily be dispelled by mounting a small bell, like a sleigh bell, on the car, which would be audible for say 10 yds., which need not be offensive, and would meet the objection that careless pedestrians might step in front of a car.

It is not for this purpose that the motorist keeps his horn on his car; he wishes to attract the attention of some individual who might possibly interfere with his progress, even to the extent of making him swerve or alter his course by a tittle. It cannot fail to have been noticed how the motorist hugs his course in the centre of the road, and refuses to give way at all, leaving the avoidance of trouble to the other party. To effect this at the high speed he desires to travel at, he must have some intermittent warning, differing as much as possible from those in ordinary use, because unless the warning stands out from its surrounding noises, it is valueless for his purposes. And continuous noise of that description would be as intolerable to him as the present intermittent ones are to the rest of the community.

If we compare the present with the horse-driving days, we find that there was plenty of noise in general, but no intermittent sounds, and fewer accidents. If this greater safety was due to the horse's intelligence, it is rather a reflection on the higher animal, man. There is, however, a psychological difference between driving an animal and a machine, and possibly this may be the reason for the present deterioration.

There is, however, the natural instinct of the horse impelling him to avoid collisions in the first place, and crushing underfoot in the second, both of which are absent in the motor car, so that the superseding of the horse has unquestionably had no little bearing on the frequency and especially the intensity of accidents.

But admitting the horse's desire to avoid collision, and the effects of it, and his superior instinctive promptitude in giving effect to that desire, which is quite unattainable in a piece of machinery, there is a further physical difference between the two methods in that the pedestrian when run into by a horse is struck by a soft and elastic body—unless struck by the shaft—which has instinctively begun to take some of its way off, while before the wheels of the vehicle with their crushing effort reach him, there is some 6 to 8 ft. of braking distance available. Even at the worst, the weight of a horsed vehicle is considerably less than that of a motor car, so that the result of the wheels going over may be less disastrous in the first instance than in the second, where the tare weight is always high.

On the other hand, when the motor car strikes an object, it does so without any elasticity, with an unmitigated blow, the shock of which may cause death even without any subsequent crushing, while there is practically no room or time between the blow and the crushing effort of the wheels.

It can be seen, therefore, that the motor car, driven badly, is a far more deadly instrument of traffic than the horsed vehicle, though, of course, properly driven, these physical disadvantages are negligible.

Another broad but important difference between the two classes of traffic is to be found in their physical attributes altogether independent of speed. The modern motor vehicle is a rigid framed rectangular vehicle from front to rear; the horse vehicle is approximately an articulated cone, with the apex at the horse's head, and the base at the rear. The articulation involves a much gentler deviation for the whole vehicle, though the ability of the motive portion to swerve rapidly in avoiding an obstruction is greater, while the fact of the one end being narrower than the other also gives much more room for give and take between road units. The modern taxi-cab or motor 'bus will deviate with extraordinary abruptness involving the whole width of the vehicle, and the whole frame rigidly from front to rear, and any cyclist or pedestrian who happens to be alongside stands little chance of perceiving the change of direction in time.

Then there is the further danger inherent in the design of the motor car, which differentiates it from horse-drawn traffic, and that is the shortness of the non-carrying portion of the car, and the compactness of the body, which excludes all view of the far side. Compare, for instance, the modern limousine with the horse carriage it has displaced, the landau. The latter is feathery, spidery almost, in comparison, with wheels in the rear of the body, so that general traffic was much less dense than now, while owing to the driver's seat being well raised, a much more general view could be obtained by all. So with the 'bus and tram —the horses allowed a view of traffic at an obtuse angle, as they occupied some 50 per cent. of the total length of the equipage, against the tram's *nil* and the motor 'bus's 15 per cent. of bonnet. It is this property that makes motor traffic so much more road efficient, but equally the difficulty of the pedestrian's obtaining a view of the road demands that the entire responsibility for running down shall rest with the driver of the vehicle.

And additionally there is the practical impossibility of the pedestrian's gauging the speed of a motor car at a moderate distance, and approaching end on. In a horsed vehicle, the animal's action shows sufficiently clearly his speed and where the danger zone lies. But with the motor-driven car of modern elasticity, even a judgment of pace would be of little use, since cars can vary their speed between, say, 4 and 40 m.p.h. in the length of a few yards. This very property alone, therefore, throws the entire responsibility for accidents on the car and relieves the pedestrian.

There remains, however, the question of the dangerous spots of traffic, where even with the exercise of care on the part of both parties accidents are more likely to happen than elsewhere. Such places are generally at oblique and multiple junctions, where anybody for safety requires eyes set in various parts of his head, since in avoiding one danger he may run into another.

Here, then, we come to the physical restriction of traffic, in the shape of the island refuge set in the middle of the roadway in order to force vehicles into certain lines, and so simplify the task of the driver, while at the same time affording a haven to the pedestrian.

It is easy to see that in a five road convergence with a high degree of congestion (and it will not take very much traffic to cause that) a driver has a great strain imposed upon him in avoiding collisions on account of the number of cross courses occurring. It may therefore be beneficial to him that traffic be so controlled, that at certain parts of the convergence he has only one or two obvious streams to negotiate, whereby he is enabled to cross with less strain and greater safety than if the whole area were unblocked. This is, of course, the principle of the kerb adverted to when considering the traffic effects of convergences, and has nothing directly to do with the safety of the pedestrian.

The effect of the refuge in this respect is very different. On the one hand, its obstructiveness may reduce speed, and so tend possibly to pedestrian safety, but at the same time it increases congestion and consequently the risk of accidents. Of course if the refuge is so aligned that it assists the free flow of traffic it will reduce congestion in spite of its obstructiveness, and so tend to pedestrian safety quite independently of whether pedestrians avail themselves of the refuge or not.

It is, however, of the refuge as commonly conceived, viz., as an obstruction to vehicles, that we are now considering it. As an obstruction, it tends to increase congestion, and with it accidents; as a haven of refuge, it tends to attract all pedestrians to cross at one spot, and so still further increases congestion. Of course where police are stationed, the inherent obstructiveness and danger of the refuge does not appear, as the police action overrides its influence.

It may seem a very dangerous idea to abolish refuges, but let us consider the position impartially. If the road is free and the pedestrian and car are both also free to proceed without any permanent obstruction, there is obviously much more possibility for give and take and for avoiding each other than where the course of each is strictly confined and intersects. To use a nautical metaphor, the more the sea room, the less the chance of collision. Even allowing for the stupidity of the pedestrian, and assuming an extraordinary negligence, he is much more easily foiled by a driver in a free road than where the only option is running into the pedestrian or the refuge.

The relative risk of these refuges can be defined mathematically. Assuming a roadway 48 ft. wide, a car 8 ft. wide occupies $\frac{1}{6}$ of the width, and the swerving or manœuvring width is 48 ft. less the car width = 40 ft., or 83 per cent. of the total road width. Now if a refuge 4 ft. wide is placed in that road, the actual width is at once reduced to 44 ft., and if a car is restricted to only one side of the refuge, to 22 ft., so that the swerving width for the car under the new conditions is only 22 ft. less 8 = 14 ft., or 29 per cent. of the total road width.

Against these physical attributes there are certain psychological influences which may have an important bearing on the ultimate value. The fact of there being a refuge in the middle of the road may encourage a pedestrian to plunge for it without regard to the traffic, with the idea that the crossing there is specially dedicated to his use, when, had there been no refuge, he would have been more circumspect.

Conversely, by separating traffic into two arbitrary streams, the pedestrian has to deal with only one at a time, and this may, perhaps, be the great and overriding virtue of the principle—at least the police in London consider them as very beneficial, and strongly recommend them to the local authorities. Under present conditions, therefore, where the driver arrogates the whole road to himself, the theoretical disadvantage may be more than counterbalanced by the practical safety it is thought to afford to the pedestrian, by dividing traffic into two defined streams moving in opposite directions, so that when crossing he need only consider the traffic to his right, and for the rest of the way, that to his left.

But if this principle is admitted and acquiesced in, it involves an entire inversion of the relative responsibilities of driver and pedestrian. It is, in fact, assuming that the latter has at all times to get out of the way of the former, and that the pedestrian has no status, except on the pavement; and it is not impossible that in this alteration of view of the respective positions of these two road farers can be found the explanation of the great and excessive increase in street accidents in London, which is not paralleled elsewhere, either in Great Britain or on the Continent.

If vehicles are driven carefully, that is to say, if drivers take upon themselves to avoid all other road farers, as they now do vehicles—for no driver when overtaking a lorry would think of doing aught else than pull up if there were no room to pass—there is no need of refuges or other obstructions. If these obstacles result in practice in a physical restraint of speed, which the police now find themselves powerless to effect morally, which may be quite possible after all the prosecutions they have had to undertake against motorists exceeding the speed limit, though otherwise driving quite correctly, the remedy is to strengthen the moral power of the police, and not to confess its impotence.

The idea of there being safety in these refuges is based on the assumption that the longer one is in the road, the greater the risk. But this premises a roadway dangerous in itself, which cannot be admitted. The roadway is perfectly safe; it is the vehicles only that may become dangerous by being improperly driven. An empty country lane is not dangerous, but a vehicle crossing it blind at 20 m.p.h. is a public nuisance and should be suppressed rather than the inoffensive pedestrian or even dog that might be run over by the driver's recklessness.

The correct mathematical argument is, the more vehicles in a given width, the more the chance of being run down; or stated otherwise, the greater the width of road for a given number of vehicles, the less the chance of being run down. It has been shown that the placing of a refuge enormously reduces the effective width of a street, so that unless it can be proved that it is of material help in protecting pedestrians, it is condemned. In practice a driver may be left with the option of running into a refuge or into a pedestrian. Instinctively he will choose the line of least resistance, and so perhaps kill the pedestrian in the road, if there are others on the refuge; or if the latter is empty, pile his car up on the refuge, to the harm of the people inside; while had there been no refuge there, he would have been able to avoid any collision at all.

But if the experiment of abolishing refuges is considered too hazardous, and the solution suggested later does not find favour, there would be less objection to these obstructions if they were shifted to points between corners instead of at the actual points of intersection. Assuming safety to repose in them, pedestrians would still have the advantage of them, while there would be far less obstruction to the vehicular traffic.

It is true that the pedestrian has to deviate somewhat, if proceeding in a straight line, but against this he is not kept waiting by the police, who would no longer be required, while vehicular traffic would be free to filter through beyond the refuge on the line of least resistance. And to prevent pedestrians from endangering their lives, the corners could be railed off from the road, from opposite one refuge to the next (Fig. 14).

If absolute safety for pedestrians is required, it is attainable only by the overbridge or subway, so that all interference is avoided; otherwise while in order to encourage the pedestrian in their use, the railing off of pavements up to the mouth of the tunnel would probably prove beneficial.

Another explanation of their present non-use may be found in the dislike of the normal person for proceeding underground, where the surface is accessible, and at present we have in England no overbridges for pedestrians to test their popularity against the subways.

That the overbridge has not become a feature of our English cities is curious, when we consider the stringent regulations imposed on railway companies with regard to level crossings, while at stations the overbridge is a far commoner means of intercommunication between platforms than the subway. It is, of course, cheaper and quicker to build, and this in a town is specially marked when the number of mains (water, electric, gas, etc.) which have to be diverted is considered. It is not only a costly but a lengthy work, and involves collision with vested interests, which is avoided if only an overbridge is erected. That the latter need not be unsightly must I think be granted, though no doubt it would be opposed on æsthetic grounds, just as was the trolley-fed tram line in the early days in London. The fallacy of this has now been seen, and the trolley has become the standard all over the world, especially on the Continent, where no one would accuse public authorities of being blind to the æsthetic value of their cities. So too, when need arises, we will find them erecting overbridges, which will harmonise with the general architecture, and be no more unsightly than the Lombards Brücke at Hamburg, or Waterloo Bridge in London. If we in England build them like Charing Cross or Blackfriars railway bridges, no doubt they will be unpopular; but with the growth of public responsibility, such fears are groundless.

There must always be danger in crossing the path of another vehicle, and in towns, often where most congested with vehicles, there is more crossing to be done by pedestrians; but the risk is not a serious one, if the driving is proper, any more than that of a Channel steamer being run down by an Atlantic liner in the Straits of Dover. With bad navigation, collisions may occur there as they do elsewhere, and undeniably the risk is greater there, because of the greater congestion, than say in mid-Atlantic. Consequently it requires greater care in navigation in spite of the seventy minutes' crossing there than in the 3½ hours' crossing between Newhaven and Dieppe, or the five or more days across the Atlantic. If this is admitted, it follows that refuges demand greater care from the public whether pedestrian or driving than the free road, and, as it is the minimum of this attribute that should be required owing to the inherent frailty of humanity, the sooner refuges are dispensed with, the safer will traffic become.

In the eternal state of human imperfection, it is not helpful to demand of the weaker the attributes of the stronger. Railways recognise this by providing interlocking for signals and points. And as it is mostly the weaker that go to the wall in traffic accidents, the blind or the deaf,

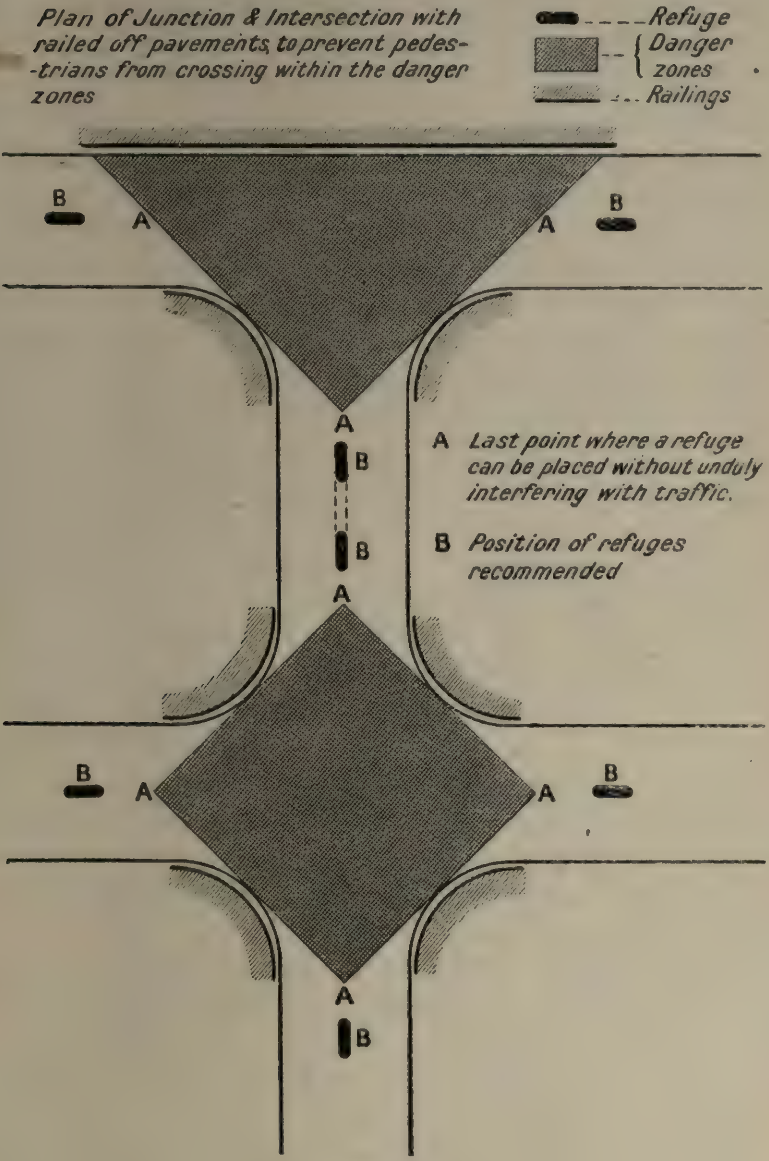

Plan of Junction & Intersection with railed off pavements, to prevent pedestrians from crossing within the danger zones
Refuge
Danger zones
Railings
A
B
A Last point where a refuge can be placed without unduly interfering with traffic.
B Position of refuges recommended

FIG. 14.

the child or the lame man, no additional strain for their own safety should be imposed on them.

Similar to refuges in their effects are trams. Advocates of this system will wonder at my contention in face of the relative figures for tram and other vehicular accidents, but as these statistics deal only with the accidents and do not show the degree of congestion or the number of the vehicles employed, no definite conclusion can be drawn from them as to the relative danger of the two types of vehicles. If the responsibility for accidents could be properly apportioned, it would be found, I think, that the bulk of accidents occurring in streets where trams run were attributable to the trams' presence. Anyone can avoid being run over by a tram because its course is strictly defined, and one encroaches at one's own risk. So people avoid trams, and throw themselves, often very suddenly, into the line of other traffic, which owing to the presence of the trams cannot swerve as freely as the nominal width of the road would otherwise allow, and so the accident happens which is attributed to the free moving vehicle. Similarly, the inability of the tram to swerve may be responsible for its colliding with some one which might have been avoided had the tram a free course. Finally, the tram is an additional source of danger, in that all travellers by it have to cross other traffic to reach it or leave it—a danger not incurred by users of other vehicles.

The solution of the difficulty of ensuring safety in crossing, which originally was responsible for these refuges, is to provide overbridges or subways for pedestrians, the former for preference, so that all danger in crossing the road would be avoided. No doubt at present the existing subways in the city of London are not too well patronised, but that is probably on account of the ease with which the pedestrian can cross at these spots, owing to the frequent holding up of the road traffic, to let alternate streams through. If this were proceeding without hindrance, in all probability he would prefer the alternative; if he did not, he would have only himself to blame in case of accident.

Especially is it no solution of the problem to fit lifeguards in front of vehicles, any more than the provision of lifeboats would be the solution of a navigation difficulty. Prevention of accident is what is required, not a palliative after the collision has occurred. It is not intended to deprecate the use of palliatives, because, of course, accidents always may happen; it is the substitution of the palliative for the cure that is objectionable. But whatever the ultimate trend of organisation and regulation, the first means of obtaining safety is the abolition of the horn or intermittent warning and fixing the prime responsibility on the driver. If sounding a horn were taken in evidence as proof of furious driving, half the dangers of the streets would be gone. Then with the normal amenities of road traffic restored, it would be possible to attend to the physical aspects of the remaining dangers.

Turning to urban railways, we can similarly see that a speeding up does not necessarily mean increased danger; only is this dangerous if the properties of that higher speed are not taken into proper consideration. Passengers are not likely to suffer more than before from being run over by trains, or electrocuted; and the risk of collision between trains has been effectually guarded against by the automatic signalling installed, which is probably the safest system anywhere. Nor need any of the reforms advocated create any danger; on the contrary, they should reduce it, as should all correct traffic principles. A five-second stop at a station may seem dangerous, because of the idea of struggle that is always associated with getting into these trains. But any actual danger occurs only at starting time, and no higher train acceleration than at present is proposed. If all the passengers were unable to get in or out in the five seconds suggested, the train would wait just as it does now; only there would be no need for it, and if thought necessary as an additional safeguard, the train could be wired to prevent its taking current until all the doors were closed.

Struggle and excitement are always sources of danger and delay, as can be seen with a theatre, which normally will empty in a few minutes, but may become absolutely blocked in time of panic. If all tendency to panic can be prevented, traffic will be found to be safer quite irrespective of its speed. Throughout the aim must be towards the equalising of the load, and in proportion as this is effected, so will safety increase. That absolute smoothness in traffic can never be obtained is as certain as the impossibility of absolute safety; but the tendency towards the one involves a corresponding movement towards the other. And tendencies are as much as can be looked for.

CHAPTER XIII

SIDE ISSUES

Æsthetic Aspect of Traffic Reform—No fear of any Loss in the Artistic Value of our Streets—Broadly speaking, Increased Efficiency means Increased Beauty — Financial Aspect — "Scrapping" of Existing Capital—All Traffic costs Money.

BEFORE leaving this review of the traffic question, it will perhaps be well to devote some attention to what may be termed the side issues, which are the by-products of any great alteration in existing methods. These, though not the prime concern of the trafficist as such, have yet to be considered and dealt with, if it is desired to carry his plans to a successful issue.

It would, of course, be impossible to deal with all the side issues that would be raised by the reconstitution of such a far-reaching factor of our daily life, but two major points occur which will undoubtedly affect a large and more thoughtful portion of the public, who would be liable to form a wrong conclusion unless they made a sympathetic study of the subject.

I propose therefore to deal with only the (1) Æsthetic and (2) the Economic sides. The latter - is, as I have already shown, the controlling factor in traffic as in all other mundane matters, and perhaps it should not therefore be treated as a side issue. But as we have been considering in the main traffic pure and simple, financial considerations, however weighty, may properly be treated as a side issue.

With regard to the æsthetic aspect of traffic, many will object that such utilitarianism, such logicality, as it is proposed to bring into traffic will render towns utterly inartistic—they will become mere aggregations of monotonous houses, vehicles, and persons, and all their individuality will be lost to them, that individuality which far more than isolated specimens of architecture is their chief æsthetic joy.

This, it may be assumed, is a groundless alarm. Although under a reformed system we should never get the intensity of the variety which now obtains in vehicular life, there would still be enough variation to satisfy the most ardent taste. Though he would not stop traffic to do so, the policeman would still pilot the old lady or the perambulator (the latter probably more frequently) across the raging flood; newspaper boys would still perform their feats of cyclemanship, not it is true beneath the heads of horses, for they would get out of practice in their art if they confined their efforts to such a field, but among the wheels of cabs and 'buses, until such time as the magnates of the fourth estate provided air-craft for the delivery of their journals; the city of London would still be barred to traffic on the 9th November, as also other favoured spots on other days of pageantry. The fire engine would still dash down the road between respectful lines of stationary vehicles, though, alas, the awful but exhilarating shout of the men will no longer be heard; for this amenity is already doomed in these pre-reform days.

And, in general, things would go on much as before, only faster and easier; there would be less waste of effort, and perhaps under the new conditions we might develop a phase of æstheticism which is as yet undreamt of. Little sympathy can, I think, be held with those who want that a house should be left to burn on account of the magnificent spectacle; or that we should not seek to abolish the smoke nuisance on account of the beautiful effects of sunlight it gives us in certain favoured spots at certain hours on certain less often favoured days.

Then, again, individuality may be a matter of pure utility also, not necessarily beautiful, though beneficial, such as the New York Elevated Railway; or, again, it may be the reverse, as in the Boulevards of Paris or the Allees of Berlin, which in the main are for beauty, and not built for traffic value.

Of course, when setting a new standard, there is always difficulty in deciding what is beautiful and what is not. One has only got to consider fashion in female dress to realise that so-called beauty often is nothing more than our momentary blindness. Yet there is an absolute standard which cannot be denied, and is not a matter of fashion, but for all time; and that is the form that combines most with utility. This only is the true standard of beauty. The architect might perhaps object to the rounding off of all corners, and the curious effect that it would make architecturally. But in the abstract this would be no more difficult or ugly—in fact it would lend itself to more diversity of treatment than the rectangular corners. There would be, or need be, no greater eyesore under reform than the railway bridge at Ludgate Circus in London without it; in fact, art and utility are each other's handmaid. An artistically laid out town will probably be better from a traffic point of view than an inartistic one. And though, no doubt, architects and artists might make traffic mistakes from an economic point of view, their sense of proportion would prevent their doing harm to traffic as is so often done by the utilitarian engineer. True art and true science must go together; it is in proportion as they are false that conflict becomes noticeable.

Leaving the domain of art and turning to the economic side, we encounter misgivings that are undoubtedly harder to quell, for the capitalist is the shiest of mortals and altogether suspicious of the reformer. "A bird in the hand" is his motto, and when you point to the two in the bush, he objects at once that he will first have to let the one he holds go before attempting their capture.

When the figures invested in tramway enterprise are considered they form such an excessively large sum, and represent such a huge expenditure of energy, that people are not disposed to abandon their capital, however unremunerative, for a problematical benefit on some additional capital.

Yet true traffic methods must be just as much true finance methods as true artistic methods, and it would probably be cheaper in the end to reconsider the situation at once and raise the necessary new capital or abandon the old with a bold hand than to carry on the existing inefficiency, in spite of a normal rate of progression.

The expenditure of "good" money to replace or to convert "bad" is always a painful undertaking, but nothing like as acute as the initial acquiescence in the presence of "bad" money at all. The human being is a confirmed optimist, and scrapping is always a more or less painful process to him. Some superlatively logical minds rise superior to the feeling; but they are, of course, a very small minority. And so it may be feared that such wholesale destruction of "bad" money will take a long time to achieve, though its maintenance every year is costing more and more.

The economist is very ready to cry out against the high rates on the Continent of Europe on the one hand, and against the sordidness of the English slum on the other, forgetting the while, as he upholds the wide continental streets and open spaces, which beautify and improve these cities, that these improvements are the direct cause of the high rates, firstly from the actual capital cost of the improvement, which is represented by an annual charge on the rates, and secondly from the enhanced desirability of the locality.

In slum districts the cost of traffic maintenance is very low—the money is spent on other forms of non-productive enterprise. Economically, therefore, it is sound to have a road of only 50 ft. wide, if it will carry all the traffic required, though no doubt it brings other false economies in its train. Still, from a traffic standpoint, a road of 100 ft., however fine and sanitary, would be a traffic extravagance, and has to be paid for in one way or another.

To make this additionally clear, let us merely consider the case of a railway, which may be forced to quadruplicate its lines in certain districts to facilitate traffic. If it could continue to do the business on the original two lines, no one would dream of incurring the expense of the widening, which would be unproductive capital, and even where potentially justified must always be a considerable tax on the undertaking until the necessity for six lines arises.

Yet—and here we have the economic situation in a nutshell—this same railway would strangle its own trade unless it incurred additional expense. It does not follow, however, that the widening is the best cure: some might consider the money laid out to better purpose on terminals, let us say; but the fact remains that the money has to be spent, and as little of it as is compatible with efficiency. And just as this is true of a commercial undertaking earning profit, such as a railway, so it is true of a road, though it may not be possible to appraise the economics in terms of profit and loss.

And so in road traffic, expenditure will constantly have to be incurred to cope with the advance of humanity. But economically in so doing, it is necessary to know clearly what proportion of all expenditures belongs to the various classes of urban improvement in order that the expense may be justified. If we take the case of tramway building in London, we find that wholesale widenings have been necessitated, not to benefit the rest of the traffic, but merely to enable trams to be operated at all. What is the result? An increase in the rates, which are lowest in all those districts where tramways are not installed. If the tramway undertaking could pay interest on this capital expenditure, the tramway would be a real boon, as it would have given the district a wider road at no cost to the ratepayer. But our municipal economists and their advisory tramway engineers have pretended that these widenings were necessary for the public welfare, and succeeded in placing the major portion of their cost on to the rates. That the district is improved sanitarily is no doubt true, but if sanitation was the sole idea, was the widening of an individual road the best expenditure to that end?

If, then, it is possible to carry all the traffic of a town on the existing accommodation, expenditure to provide further room is merely wasteful; if, again, more accommodation is required, it must be of the right kind and of the best value; and then just as needless expense, however small, is waste, so justifiable expense, however large, is economic.

Would, for instance, the wholesale reconstruction of the underground lines in London be economically "justifiable"? More than all, would the scrapping of the tramway systems be a move in the right direction? If the principles are right, they are justifiable economically, just as the Mersey, Metropolitan and District railways' electrification has been, however unfavourable the schemes appeared financially at their inception.

In actual fact no little has been done, both in London and elsewhere, to improve the traffic value of the various railway properties by the expenditure of considerable sums of additional capital; but far more remains to do, if a maximum of utility is to be made of the existing lines. There is, however, more hope for the reconstruction of railway traffic than there is of road traffic, for the very reason that the one is a business undertaking while the other is in the hands of capitalists who for the most part can and do run their road ventures for their own glorification, without regard to the economics of the matter. I refer, of course, to the many municipal ventures in tramways in which the possibility for perversion of the true financial facts is only equalled by the advantage that is taken of it.

When it is considered what a volume of traffic passes down such a street as, say, Cheapside in London, it is absurd to incur huge expenditures in widening roads with not half the traffic for the purpose of installing trams. Yet new capital will eagerly be raised on the security of the rates to perpetuate a false principle, because the loss to the community is safe from discovery.

And so traffic conditions grow worse and worse, while the very causes of the deterioration are reproduced year by year with pathetic exactness.

CHAPTER XIV

CONCLUSION

Difficulty of Effecting Reforms—Variety of Authorities—No Traffic Experts in Practice—Otherwise each Town should have One—Prevention of Congestion Better than Cure—Necessity for Traffic Officers—Analogy from Docks and Railways—Conclusion.

We have now passed briefly in review all the ordinary phases and manifestations of urban traffic, and to those who have followed the arguments set forth, it will be apparent that there is no small task in front of the traffic reformer. And its magnitude is the more intensified by reason of its impalpability: the jelly fish is not more invertebrate than the control of traffic.

Let it be assumed that, burning with the righteousness of the cause, one attempted to get the central obstacles removed. To whom should one go? To the borough surveyor? Presumably so: and one would find a very sympathetic official, who would accord one a very courteous though sceptical hearing, and then refer one to the police, as being the authority having control over traffic, and primarily responsible for the erection of the obstacles by the borough. The police would probably differ as to the correctness of the reform point of view, and there the matter would then end, unless one were successful in moving some voting influence.

But even supposing that the police were convinced of the error of their earlier theories and practice, and afforded every assistance in the campaign, the actual abolition of the obstacle would still be very remote. The borough authorities would be inclined to discredit the value of an opinion, which had veered so completely. And then again, who would compensate the borough for the value of all these refuges? And who would pay the cost of their removal? And who would reassure the public, who have for so long had the value of these refuges dinned into their heads?

The difficulties are almost insuperable under present conditions, where there is no expert knowledge or the responsibility which it would engender. There is only one means as it appears for advancing in this matter; and that is for towns to appoint traffic experts, who would be responsible for the proper conducting of the traffic, and have all the powers necessary for that end. At present none such exist, nor is there any school where the principles can be taught; so that the remedy seems rather hopeless. But assuming the expert in being, his function would be to supervise everything that had to do with the roads and traffic on them, exits from houses, encroachment permits for building, central obstacles, breaking up streets, paving and repairs, point police and so on, while he would, of course, make all the recommendations as to the actual lay out of roads, such as widening, etc. His powers would merely be consultative, but in practice his employers, like all sensible employers, would be guided by the advice of their expert, and the position would be extremely responsible. The situation would be akin to that suggested by the Royal Commission for London of a Traffic Board. And again, why London alone of all towns should have its traffic advisers, while Glasgow, Liverpool, Manchester, and so on should not, seems unreasonable. Allowing for their not being in such straits at present as London, on account of their smaller size, with the normal growth they may even surpass London's difficulty in time, on account of the greater tram operation. Now is the time to take their problems in hand, before they become unwieldy. In nothing is the old adage more true than in traffic that "prevention is better than cure."

For those small towns who cannot afford a trafficist of their own, there would in the future be consulting trafficists, who would give advice on all subjects connected with traffic improvement or regulation, as they were required. But all big towns would have full employment for a trafficist and a large department behind him, if the advisory functions outlined above were entrusted to him.

By such means the conducting of traffic everywhere would tend to become co-ordinated on scientific lines, and real progress might be made. Doubtless in detail there would be many a difference, but equally there are physical differences in districts which would require different treatment. The principles, however, would become firmly established, and that is what would really matter.

No doubt the present regime would scout the idea of having a traffic adviser; at least no community has appointed one. People imagine that traffic on roads can run itself, or that its handling can safely be left to the town engineer or surveyor, or to the chief constable. Probably most persons would say that it was a matter for the engineer, if for anybody, though in reality there is little in common between the two professions.

A dock corporation employs a traffic manager, quite distinct from its engineer, and railways maintain traffic officers in large numbers, who run the economic side of the line, quite independently of the engineers who are responsible only for the physical state of the line and stock and for supplying the traffic specialists with their requirements. It is not the chief engineer but the traffic superintendent who calls for a widening, a flying junction, a heavier locomotive, or an automatic signalling plant. In towns, though the borough surveyor may know no little about road crusts and foundations, and the tramways manager may be making a fine profit for his employers out of their venture, while the police are preserving exemplary order, comparable only with the sanitation maintained by their health officer, there is no one to decide the traffic aspect of any scheme advocated by these specialised officers of the corporation. The borough surveyor wants to repave a certain road with a new and much cheaper medium ; who decides whether it is suitable from a traffic point of view, and economic? The tramways manager wants to run a line down a certain street; who decides whether this is advisable in the general interest? The police want extra refuges; who decides whether they are to be allowed, and at what spots? The health officer condemns a slum district; who designs the roads in the new area to conform with the existing traffic? A building permit for an encroachment is required; who decides its extent, position, and the duration of the permit? A road falls into disrepair; who is to condemn it and order its repaving? Obviously the surveyor's department will leave it out of order as long as possible, in order to reduce departmental expenditure. Surely such a variety of duties demands a special officer with technical training in his responsibilities, if they are to be efficiently fulfilled.

The establishment of a Chair at some university would be a move in the right direction. The principles here laid down require examination, comparison, and if possible experiment under actual conditions of working, before they can be certainly adopted for the general benefit. And again, although these principles might be theoretically established in their entirety, there would still be difficulty about translating them into practice, which would probably cause considerable modification; there would be the tremendous financial difficulty, while the public themselves would require a certain amount of education to accustom themselves to the new conditions, so that for many years to come there would be both systems in operation, the old gradually being ousted by the new.

And in this way and only so can the reform of traffic be made satisfactory. If any attempt at wholesale reform is made, it can only result in disaster and trouble to the community—traffic is not exempt from the operation of natural laws, which demand that all changes to be beneficial must be gradual. Nature is only destructive in her rapid changes; she builds an oak in a century, and destroys it in a second. If we wish to construct, it must be upon Nature's gradual lines, without attempting to do more than she permits. Too often have new schemes for improvement, perfectly sound in their theory and ideals, been wrecked by the extravagance of the zeal of their promoters. Politics are full of such mistakes and abortive efforts; and so might traffic be. And then the last state would be worse than the first.

"Go gently, but keep on going" is an all-round motto for the trafficist. And though the pace may not be as high as the 100 H.P. reformer would like, he will still reach his journey's end, and in less time than before, without leaving a trail of death and hate in his wake, which, however callous he himself may be to it, does not show that state of general happiness which it is the duty of all to strive for.

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